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DESIGNING FOR IMPROVED PERFORMANCE.

~~FINAL REPORT~~

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TELECONFERENCED GROUP DECISION MAKING: DESIGNING FOR IMPROVED PERFORMANCE

PART II

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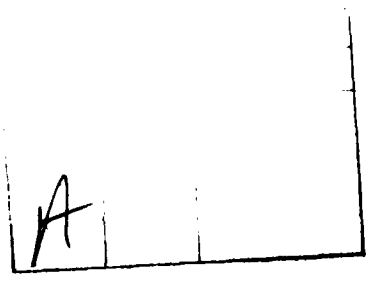


TELECONFERENCED GROUP DECISION MAKING: DESIGNING FOR IMPROVED PERFORMANCE

PART II

INTRODUCTION: RESEARCH PROCEDURE

The effect of the teleconference upon the participants and the meeting itself during the decision making process was investigated using a number of different tasks. These tasks, which are described fully in Annex B, were selected to satisfy a range of meeting characteristics. Tasks were defined in terms of the competitiveness or cooperation necessary, the amount of information provided and the relative importance of the generative and evaluative stages. For each characteristic, the goodness of the outcomes arrived at indicate the relevance of any changes due to the alteration of the discussion medium. A number of factors, which were likely to change, were identified. For instance, the brevity or task oriented nature of the meeting and the attitude or performance of the participants, were all measured. The relative suitabilities of a teleconference for different purposes can thus be discussed in terms of their characteristic qualities; and any changes in style may be predicted.

The goodness of a discussion was found, if possible, by evaluating the group's answer. However it is difficult to have a unique correct answer while avoiding purely analytical problems which can be solved individually without recourse to any communication. A further constraint is that the tasks should require no technical knowledge. This enables one to use subjects from a wide range of professions and not be restricted to a small potential pool of recruits. To cope with both of these points tasks were used which involve prediction of some aspect of the future or which can be evaluated in comparison with expert opinion. For the remainder of meetings, including the real ones, the research relies on subjects' own opinions on the success of the meeting and their own performance.

As can be seen in Figure I.1, the tasks each have a particular dominant characteristic. The one characteristic which it is not possible to manipulate is that of subject interest or motivation. It is not possible within an unreal task to examine a very tedious or highly complicated meeting, since there is not, for instance, the fear of loss

FIGURE I.1 QUALITIES OF TASKS

Task	Characteristics of the Tasks' Discussions							
	Subject interest	Cooperation	Competition	Generation of ideas	Evaluation of ideas	Much information	Emotional content	Whether Evaluation of outcome is possible
Tour of London	√√√	√√	-	√√√	√	√√√	-	√
Spinoff	√√√	√√	√√√	√	√√	√√	√	-
Town planning	√√√	√√	√√	√√	√	√√√	√	√
Maier I	√√√	√√√	√	√√√	√	√	√	-
Maier II	√√√	√√	√√	√	√	-	√√	-
Maier III	√√√	√√	√√√	-	-	-	√√	-
FT game	√√	√√	-	√	√√√	√√	-	√√
EIA tasks	√√√	-	√√	-	√	-	-	-
Attitude questionnaire	√√√	-	√√	-	√	-	√√	-
Overall coverage	√√√	√√√	√√√	√√√	√√√	√√√	√√	√√

√ Presence of quality

√√

√√√ Dominant characteristic of meeting

of job, or money, which in a real meeting may be associated with a participant's decision not to continue. Instead we had to provide an atmosphere in which people were self-motivated to perform well within a respected group. We did, however, arrange for a number of real meetings to also take place over the system and one of these was a very time-consuming affair lasting a week.

The groups involved in almost all meetings were composed of four persons. The decision to use four-person groups took into consideration both the practicalities of research and the need to extrapolate findings to an operational teleconference system with larger group sizes. The practicalities of the research dictated that group size should be kept to a minimum. The technical problems of building a teleconference system multiply with the number of nodes to be linked-in. Specifically, the problem of "howl-around" on a open audio system becomes acute with more than four nodes. In addition the day-to-day running of experimental sessions, relies on the ability to recruit groups of participants. The ease of this recruitment, and the reliability of all participants attending, decrease markedly as the group size increases.

On the other hand, the focus of the research was group teleconferencing. Previous research on teleconferencing had found that three-person groups behaved rather strangely. In almost any discussion they rapidly broke down into a paired coalition against the single remaining member. The addition of a fourth member to the group restores balance, and evokes behaviour more suitable for extrapolation. The four-person group was therefore selected as the minimum size appropriate for the research, and the maximum size desirable to avoid spending excessive amounts of time on practical problems.

Participants who took part in the teleconferences fall into three main categories:

1) those recruited for one lunchtime session,
2) those recruited for a week long session, and
3) company employees who held their meetings over the system.

The majority of participants belonged to the first group, in total contributing 113 man-hours of teleconferencing. The basic research procedure was for the participants to be briefly introduced to the system

and its operation, then given a discussion task which usually lasted 40 minutes. At the end of this task, the participants completed a short opinion questionnaire, then discussed their experience and impression of the teleconference with a member of the research team, over lunch (a cold buffet held in the discussion room of the research suite). The questionnaires were initially concerned with the ergonomics and operation of the system, but once most problems had been overcome, the questionnaire was changed to focus on the experience of the meeting with similar meetings held in person. A copy of the questionnaire is contained in Annex B.

Participants attending the lunchtime sessions were generally members of a workgroup from a single organization. They therefore had already established their working relationships. The same is obviously true of meetings held involving members of CS&P. The members of the second category, however, were recruited so that they had not previously met, and there were no established hierarchies.

In addition to these experimental participants, others used the system in the course of visits to the company for discussions on subjects related to teleconferencing. As these visitors generally had considerable experience of operational teleconference systems, their opinions and comments were particularly sought. In total the system was used and evaluated during 1140 man-hours of teleconferencing in over a hundred discussions. By using a variety of participants the research team was able to base its research on usage by a wide range of professional people.

It was not attempted to set up control groups who met face-to-face to solve problems, since this would have been wasteful of the time given to us by our subjects. Instead, where particular procedures or treatments are applied, comparisons are made among similar subjects, who act as their own controls. Lunchtime sessions are compared and for the week long sessions, results for each particular day are compared. In such a way it is possible to observe the differences between different teleconference or meeting arrangements. The overall perceived differences between participants' face-to-face meetings and their teleconferences (chapter 6) rely on participants' own reports given in questionnaires, and on the extensive debriefing sessions which followed each meeting.

Some sessions were, however, held without the video channel. These are referred to as 'audio only' meetings.

5. THE DEVELOPMENT OF THE TELECONFERENCE SYSTEM

The operational system described in chapter 2 of this report was the end product of the original knowledge and ideas on teleconferencing of the research team, augmented by the practical experience, especially in the early stages, of the ongoing meetings.

This chapter describes and discusses some of the ways in which the physical system underwent changes during the phases of research, together with the impact of novel aspects of the system and implications for potential enlargement in number of participant stations.

The basis on which developments and modifications were made were the informal comments of the early users coupled with observation by the researchers of problems encountered by participants.

5.1 Indicator Lights

It can be seen from figure 2.3 that there is an indicator light adjacent to each monitor in the array. Originally these were switched from the controller's audio switching unit to indicate automatically the loudest microphone input. The idea was that one at a time would light up to draw participants' attention to the subject who had most recently commenced speaking, or started to interrupt. However when these lights were implemented it was quickly realized that:

- The light became too strong a focus of attention such that speakers attached too much importance to their own indicator being lit. Whatever volume thresholds were set for operation, voices tended to be raised unnaturally and various tricks such as coughing or leaning towards the microphone were adopted to ensure capture of the light. When a speaker's light was lost during an utterance, the distraction was so great that there was invariably an abrupt pause for the thread of thought to be regained.
- Conversely, when the indicator lights were switched off it was apparent that no difficulty was usually experienced in identifying the source of remarks addressed from any quarter. Even four strangers who would not have previously become accustomed to each other's voices showed no such confusion even during heated discussions with everyone joining in.

The reason for the initial implementation of the indicator light switching was thus found to be insupportable and since they were obviously a considerable distraction, the facility was dropped from all further sessions.

5.2 Chairman Sessions

The flexible positioning of the control panel meant that it could be removed altogether when desired. This enabled "purely open" sessions to be run without use of the private system or other switching. Furthermore, by giving only one participant the use of a control panel, it was possible to contrive a chairman's role based on the ability to speak privately to the other participants and the controller. The degree to which chairmanship could be conferred on an arbitrary participant could thus be investigated.

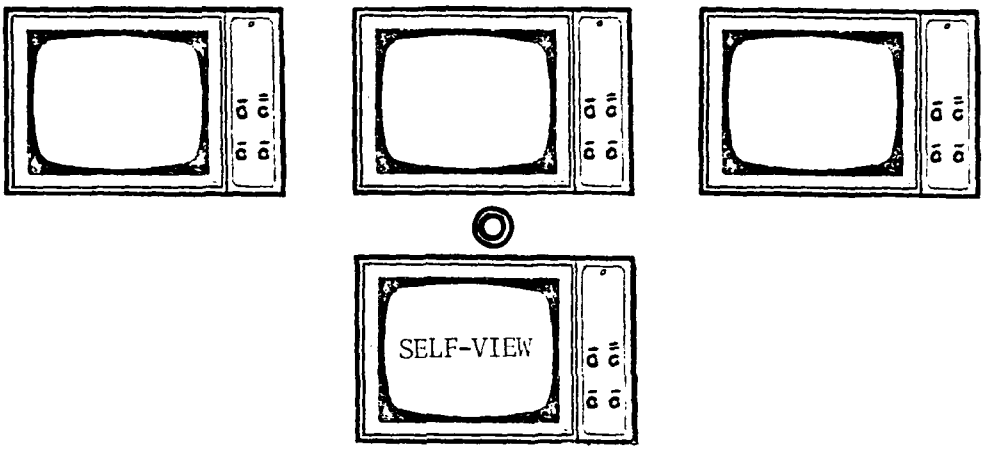
Other possibilities with reduced level of control that were tried out involved covering parts of each of the control panels so as to leave available, for instance, just the audio functions.

5.3 Self View

It would be reasonable to question the need for a self view monitor image since the primary function of a video teleconference requires the images of only the other participants. This matter was given careful consideration in the design stage, together with the various ways in which the monitors could be arranged and the final layout was chosen for the following reasons:

- The most straightforward motivation for including a self view is that it is quite simply the most effective way of keeping people in camera shot. Even though there would seem to be a limited room for manoeuvre whilst sitting at a desk, it is remarkable how people manage to drift gradually out of camera view when they have no feedback to make them aware of their position. On many occasions when the self views were deliberately withheld by the controller, after a time some participants tended to adopt positions either sideways on or partly or wholly out of the field of view. When, in these situations, the self views were re-presented, the participants almost immediately realigned themselves with the camera.

- The inclusion of a self view together with a varying position for it within a fixed A, B, C, D array from room-to-room, was felt to provide a methodologically helpful level of covariance. It means that each participant is confronted with exactly the same format of images. If on the other hand the self view takes some "special" position, as for instance:



  - then the three other monitors must vary in some cyclic permutation among participants from room-to-room. The same is obviously true is there is no self view monitor present. The importance of this is that if there are any significant biases resulting from the relative position of participants' images then such effects will be consistent for any single meeting and will show up more readily than if a participant appears to each of his colleagues in a different position.

- Although it was anticipated that some people might feel self-conscious or even uncomfortable when faced with themselves on "television", it was felt that this was in itself of some relevance to the way we were looking at teleconferencing. It was thought valuable, then, at least to have the self view facility available so that some idea could be gained of how prevalent such self-consciousness is and of how important it might be in influencing people's behaviour during a teleconference.

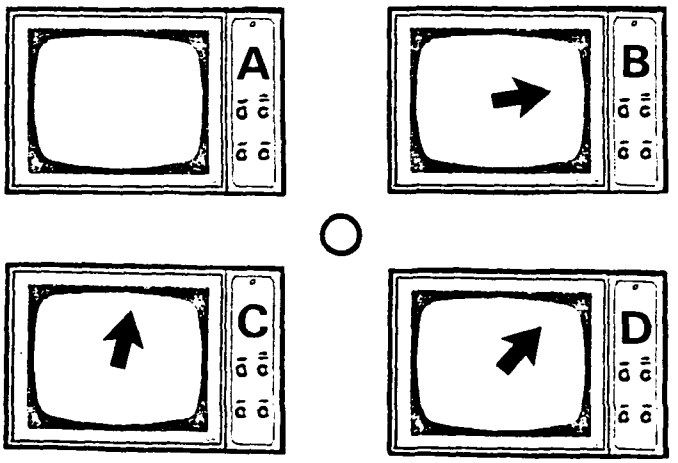
There was a further 'serendipitous' advantage of considerable significance gained from having the self view in the arrangement chosen.

This was discovered after implementation, when the horizontal scanning direction of the cameras was reversed, and is discussed in section 5.4.

5.4 Forward v. Reverse Scanning

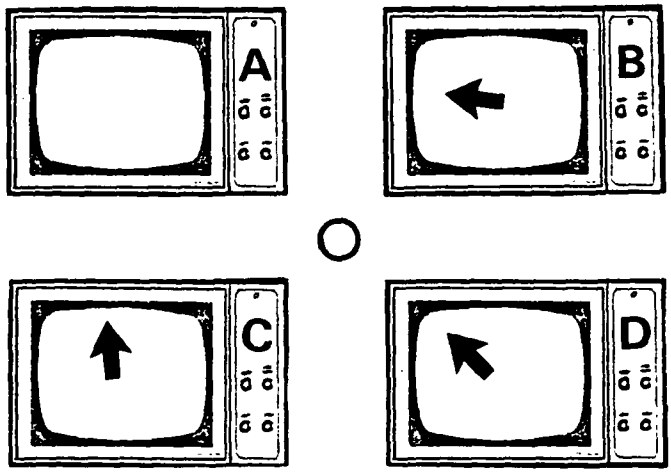
The system was initially used with unmodified camera scanning. This meant that:

- The "self view" presented to each person was not a mirror image but was instead the view that the camera (or another person) would have of them, turned round to face back the other way. This means that all movements are seemingly reversed. If, for instance a participant points towards the window say, then the image in the self view monitor points towards the opposite wall.
- The other three participants appear as they would "in the flesh". This, however, again causes problems due, for example to the right hand side, of the viewer being in the opposite direction to that of the image viewed. If, for example, A is talking and B, C and D are all looking at their A monitor, then the directions of gaze of the images are as follows:



This was obviously confusing and many subjects reported the images "distracting" even when the source of the confusion was not identified. Note that it is only the horizontal direction that is wrong; when A and C or when B and D look at each other, the direction of gaze is faithfully represented by their images. This is because "up" and "down" are the same directions for both person and image.

It is not difficult to appreciate then that reversing the horizontal scan of the room cameras made an enormous improvement in reported "naturalness" by making the direction and object-person of moment-by-moment glances easily recognizable. This is evident by comparison with the previous example:



The small price paid for this convenience is that participants appear to each other to be reversed with respect to things like hair-parting, buttonhole, wristwatch hand etc.. However, since human beings are reasonably symmetrical, this reversal is far from obvious unless there is some gross asymmetry present, such as an eyepatch.

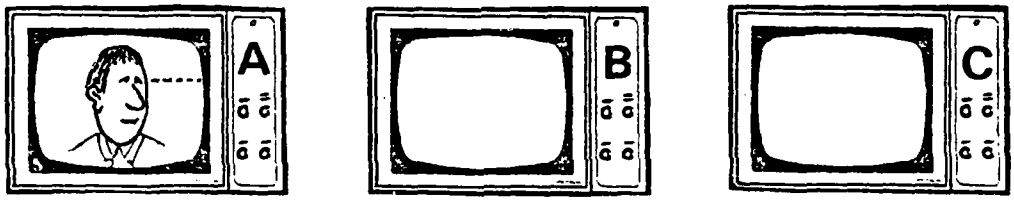
The self view image now appears almost completely natural as would be expected since everyone is accustomed to their mirror image and the self view differs from this only in that it does not look straight back out at the observer.

A further value of having this self view present (see last section), is clearly that it provides a focus for the directional gaze of other participants looking at the corresponding image in their rooms. Admittedly, the off-centre directions of these gazes is a result of using one camera per station, but it does seem from the debriefing discussions that people have no difficulty in identifying with the self view image for the purpose of rationalizing others' gaze direction.

5.4.1 Extrapolation of array size. An advantage of arranging any kind of objects in a two dimensional array when they are required to be

persistently watched is that the overall linear size that must be held in the field of view varies only with the square root of the total number of items.

For instance, an array of nine television screens is only 50% wider in any direction than an array of four. This would suggest that the video side of our teleconference system is readily extrapolatable to a considerably larger scale. This is in fact only partly true since the unambiguous gaze direction vectors discussed in the last section are immediately lost with larger systems. For example in the diagram below it is difficult to determine whether participant A is looking toward B or C:



Resolution of this ambiguity would require an intuitive determination by the onlooker, of the degree by which gaze is angled on the part of the image. Given that there is an inaccuracy of gaze direction in any such image, inherently resulting from camera and self view monitor not being coincident, it is not known whether the necessary perceptual resolution is possible. If the specific identification of such gaze is sufficiently important then consideration will need to be given to alternative monitor/camera layouts in larger multipoint systems.

5.4.2 Extrapolation of private channels. Technically, there is no obstacle to increasing the sophistication of private channel switching to suit larger scale teleconference networks. Methodologically, however, the decisions involved in designing any particular scheme of switching logic become rather complex and arbitrary. Considering a 9-point system by way of example, one has to decide, without any real foundation for judgement the following detailed structure:

- Is it to be permitted that all 9 people be simultaneously engaged privately?
- If not, what is the minimum number of people that must be left on public?
- What is the maximum number of people that may be simultaneously linked together privately?
- Is it to be possible for a person to hear more than one private communication simultaneously?
- If so, are private collusions to be automatically expanded to include a caller to any of those already engaged? (i.e. is the operation of calling privately to be transitive?) For example, if A and B are in private communication and C calls B, is an A-C link created automatically then, or only when B returns the call to C, or not at all?

Unless a very simple scheme is adopted, such as allowing only a relatively small number of non-overlapping two-person links, the system is likely to be highly confusing to the participants. For the 4-point system used in this research, the single two-way channel used seems to have been about the optimum choice but for any larger scale teleconference networks the design of any private communication facility would have to be considered specifically on the basis of the individual requirements of the system concerned.

6. PERCEPTIONS OF TELECONFERENCING

6.1 Perceived Differences in Teleconference Meetings

Since it was not possible to observe subjects' behaviour in their usual face-to-face meetings, they were asked to consider the teleconference, in which they had just participated, in terms of their expectations or knowledge of similar meetings held under face-to-face conditions. Figures 6.2, 6.3 and 6.4 show people's opinions of the quality of their meetings both for when there was full audio-video, and for when there was only audio contact. People were likely to be as satisfied or more satisfied with their audio-video teleconference compared to face-to-face. In addition about half of the subjects found the audio-video teleconference more task oriented and 40% found it less time consuming. This favourable response can be seen to be not just due to our subjects' indiscriminate support for technological equipment or gratitude for a diverting lunch-time,when one compares these results with the ones for audio-only teleconferences. These subjects were more likely to be dissatisfied with an audio teleconference with a large proportion considering them to be less task oriented and more time consuming than face-to-face meetings.

People's perceptions of themselves are covered in figures 6.5 and 6.6. The majority of people (70%) felt they contributed towards the meeting and controlled the directions taken by the meeting to similar extents in the audio-video mode as in their normal face-to-face mode. The values for audio-only teleconferences, though based on a much smaller sample, tend to show a larger degree of dissatisfaction that people feel with their success at putting over their own points of view.

Greater differences are observed when subjects' perceptions of their colleagues are given. As shown in Figure 6.7, nearly a third of subjects said their colleagues, which they may or may not have met prior to the meeting, appeared more cooperative than their expectations of people at similar meetings. Comparing this with the results for the audio teleconferences where only a fifth of subjects so replied, one can assume that this result is not simply due to a lack of personal interest in the success of the meetings. As shown in figures 6.8 and 6.9, there are some reports of one's colleagues over an audio-video teleconference appearing less aggressive and more friendly. The results for the audio-only

FIGURES 6.2, 6.3 and 6.4 PERCEIVED QUALITY OF MEETINGS

%s of subjects
Bases = 171, Audio and video
20, Audio only

FIGURE 6.2 SATISFACTION

	Audio-video	Audio only
Prefer teleconference	35	5
Equal	48	30
Prefer face to face	17	65

FIGURE 6.3 TASK ORIENTATION

	Audio-video	Audio only
Prefer teleconference	48	10
Equal	44	60
Prefer face to face	8	30

FIGURE 6.4 BREVITY OF MEETING

	Audio-video	Audio only
Prefer teleconference	40	25
Equal	44	40
Prefer face to face	16	35

FIGURES 6.5 and 6.6 PERFORMANCE OF SELF

%s of subjects
Bases = 171, Audio and video
20, Audio only

FIGURE 6.5 CONTRIBUTION TO DISCUSSION

	Audio-video	Audio only
Prefer teleconference (i.e. contributed more)	15	5
Equal	69	65
Prefer face to face	16	30

FIGURE 6.6 CONTROL OVER DIRECTION TAKEN BY THE MEETING

	Audio-video	Audio only
Prefer teleconference (i.e. had more control)	17	10
Equal	69	50
Prefer face to face	14	40

FIGURES 6.7, 6.8 and 6.9 PERFORMANCE OF OTHERS

%s of subjects
Bases = 151, Audio-video
20, Audio only

FIGURE 6.7 COOPERATION OF OTHERS AT MEETING

	Audio-video	Audio only
Prefer teleconference (i.e. others were more cooperative)	31	20
Equal	54	60
Prefer face to face	15	20

FIGURE 6.8 AGGRESSION OF OTHERS AT MEETING

	Audio-video	Audio only
Prefer teleconference (i.e. others were less aggressive)	19	25
Equal	66	60
Prefer face to face	15	15

FIGURE 6.9 FRIENDLINESS OF OTHERS AT MEETING

	Audio-video	Audio only
Prefer teleconferencing (i.e. others were more friendly)	18	5
Equal	73	75
Prefer face to face	9	20

FIGURES 6.10, 6.11 and 6.12 PERCEPTIONS OF EQUIPMENT

%s of subjects
Base = 171, Audio-video
20, Audio only

FIGURE 6.10 DISTRACTION BY EQUIPMENT

	Audio-video	Audio only
Distracting	26	35
Not distracting	74	65

FIGURE 6.11 PECULIAR VISUAL ARRANGEMENT

	Audio-video
Peculiar	29
Not peculiar	71

FIGURE 6.12 HELPFULNESS OF EQUIPMENT

	Audio-video	Audio only
Helpful	67	25
Not helpful	33	75

teleconferences show likelihood of a reduced level of aggression but also a reduced level of apparent friendliness.

6.2 Perception of Teleconference Equipment

Over two thirds of subjects were not at all distracted by the equipment, nor found the visual arrangement peculiar in any way (figures 6.10, 6.11). Overall the equipment was thought helpful to their meeting procedure and outcome (Figure 6.12). Thus we can conclude that the beneficial effect of many shorter and more task oriented meetings is not due to a preoccupation with getting off an unpleasant system. The last figure is interesting in that it is a measure of people's willingness to use the system again. Here we find that even without separation of participants making teleconferencing an attractive alternative to travel, people may prefer such meetings for advantages apparent in the meetings themselves. This last point presumably cannot hold for our audio-only teleconferences, because after these sessions, three quarters of the subjects considered the equipment not helpful to their meeting.

6.3 Implications

One can conclude a likely greater satisfaction with these audio-video teleconferences associated with their more task oriented and less time consuming nature. This comes about with a more cooperative group, whose cooperation is not, however, at the expense of any reduced levels of personal contribution or control. Apparent levels of friendliness and aggression show little change. There is only a slightly increased likelihood of the others appearing more friendly and less aggressive. This is not large enough to signify a determination to come to any agreement without proper evaluation of all possibilities, but perhaps merely a compensation for any reduced level of social presence due to the media.

7. THE RELATIONSHIP BETWEEN TASK TYPES AND TELECONFERENCING

7.1 Competitive and Cooperative Tasks

Figure 7.1 shows how the tasks used fall into two broad categories, those where cooperative behaviour is suitable (i.e. the group's interest equals the individual's) and those where there is some degree of conflict between individuals' preferred outcomes. In both types there will, of course, be some competition to have one's own ideas taken up, but for the latter a particular agreed outcome will benefit each group member differently. Evaluation is thus more difficult, since the most successful meeting might be the one where any one individual gains most or alternatively where some average gain of the group is largest. It is easier to identify bad meetings in which discussion, for instance, ends without any agreed outcome.

FIGURE 7.1 TASK TYPES

Cooperative tasks	More competitive tasks
Tour of London	Spinoff
Financial Times Index	Maier II and III
Maier I	EDA tasks
Town planning	Attitude

As can be seen in Figure 7.2, reported improvements due to the teleconference over a similar but face-to-face meeting are much more frequent for the competitive tasks. It is these meetings that are marked by greater satisfaction, more task orientation, and greater personal contribution and level of control. The numbers of increased personal contributions and more task oriented teleconferences reported are significantly higher for the more competitive tasks than for the cooperative ones. Cooperative tasks are not thought in themselves less interesting or motivating nor is there any greater frequency of negative or dissatisfied reports comparing such meetings with similar face-to-face meetings. Instead, it seems that the advantages of the system, apart from the generally held view that meetings are as or less time consuming, become most apparent when the discussion is heated.

Examination of Figure 7.3 shows a much greater variance in the

FIGURE 7.2 QUALITY OF DISCUSSIONS

%s of subjects
Bases = 73, Cooperative tasks
76, Competitive tasks

Opinion held (compared with face to face situations)	Cooperative tasks	More competitive tasks
More satisfied with meeting	25	39
More task oriented[1]	47	64
Less time consuming	37	39
More individual contribution[2]	8	28
More control of direction taken by meeting	18	28

1. Probability that the null hypothesis (that there is no difference between task types) is true is <0.05 on a two tailed Chi-square test.
2. Probability that the null hypothesis is true is <0.01 on a two tailed Chi-square test.

FIGURE 7.3 SUBJECTS' PERCEPTIONS OF THEIR COLLEAGUES' BEHAVIOUR

	Cooperative	Aggressive	Friendly
More so than in face to face equivelent	37 / 22	8 / 32	16 / 18
As in face to face equivalent	52 / 40	74 / 48	79 / 70
Less so than in face to face equivalent	11 / 38[3]	18 / 20	5 / 12

% subjects in cooperative tasks (base = 73) / % subjects in competitive tasks (base = 76)

3. Probability that the null hypothesis (that participants are not perceived as less cooperative in competitive tasks) is true is <0.0005 on a one tailed Chi-squared test.

reports of a colleague's attitude in a competitive situation. There are larger frequencies of both greater apparent aggression and less apparent friendliness. Thus it would seem that the preferred nature of the audio-video teleconference for more competitive tasks may be due to the more emphatic portrayal of one's reaction to ideas or comments. This may come about to compensate for a lowered social presence felt when using the system. The advantages of the teleconference are thus that there is clear feedback on a colleague's reception to one's contributions, while reducing the unproductive side-talk which is reduced in all meetings studied, making for more task oriented and briefer meetings.

The classification of meetings as cooperative or more competitive is supported in a significantly higher proportion of apparently less cooperative colleagues among competitive meetings and a higher proportion of apparently more cooperative colleagues among cooperative meetings (see Figure 7.3).

It is perhaps unfortunate that the meetings which appear to be most successfully improved are the ones which, as already mentioned, are hardest to evaluate. No meetings were obviously bad, only in a couple of attitude discussions did the group resort to averaging. Comparisons are made between those groups who performed well on the cooperative tasks and those who did less well (see Figure 7.4). For most observed qualities there is no difference. However there were a significantly high proportion of groups in which a member considered he or she had more control over the direction taken by the meeting among the cooperative groups which made the best decisions. Similarly, a high proportion of these group members considered their colleagues to be more friendly. The former finding that the easier emergence of a leader may help the goodness of decision outcome is discussed further in the section of chairmanship (9.6).

However it is necessary to increase the numbers of groups using each task before any confident conclusions may be drawn. The correlation between emergence of someone taking more part in the direction taken by a meeting and the goodness of the decision outcome does not necessarily imply a causal relationship. It could be that some aspect of the greater task oriented nature of the meeting enables both the emergence of a clear leader and a good decision outcome.

FIGURE 7.4 DIFFERENCES BETWEEN THE MOST SUCCESSFUL COOPERATIVE TASK GROUPS AND THE REST

Comment given by at least one group member	Better groups (Base = 8 groups)	Worse groups (Base = 7 groups)
	(Proportion of groups)	
Equipment is helpful	1.00	1.00
Discussion is more task oriented	.87	.86
Others are more cooperative	.75	.86
Discussion is less time consuming	.75	.71
Others are more friendly	.75	.43
I have more control over the direction taken by the meeting[1]	.75	.29
Others are less aggressive	.50	.71
I am more satisfied	.50	.71
I am distracted by the equipment	.50	.57
I contributed more	.37	.29
I contributed less	.37	.14

1. Probability that the null hypothesis (that there would be no higher frequency of favourable remarks from the better groups) is true is < 0.05 on a one tailed Fisher test.

7.2 Generation and Evaluation Stages

A number of steps or stages have been identified in decision making literature. The two easily identifiable stages of Osborne (1957) are referred to here. The first generative stage is concerned with the listing of possible actions or ideas. The second evaluative stage is concerned with the evaluation of these ideas and the selection of one of them as the agreed decision outcome. These stages may be completely separate, the one following on from the other, or on the other hand, all ideas may be evaluated as and when they emerge.

To investigate these stages the tasks are divided into two groups (see Figure 7.5). In the first group the predominance of time and effort must be spent thinking up possible ideas. In the second, it is necessary to agree upon a single value or option as an answer as opposed to a list of recommendations or one many staged decision, both of which may allow for some representation of all views. The emphasis is thus on either on the generative stage or the evaluative stage.

As can be seen in Figure 7.6, there are few perceived differences in the qualities of the two meeting types. Among those tasks which concentrate on the generation of ideas, there is a greater likelihood of the ensuing meetings being briefer. While among the others, which concentrate on the evaluation stage, there is a greater likelihood of conferees feeling able to contribute more to the discussion. Since all the tasks contain some element of both idea generation and subsequent evaluation any significant result using them may need many more experimental sessions.

Tasks more suited to investigation would contain only one such element. A list of answers may need to be created or alternatively subjects may be presented with a list of possible outcomes and have to choose that which is best. Such tasks were not used at this stage of the research, because their restrictive nature sheds little light on the other processes being investigated.

However, it would seem that most economies in time may be made in the initial stages of a meeting and the release of inhibition applies most at the time for criticism of ideas.

FIGURE 7.5 DOMINANT CHARACTERISTIC OF TASKS

Generation of ideas	Evaluation of ideas
Tour of London	Spinoff
Town planning	Financial Times Index
Maier I	EDA tasks
	Attitude

FIGURE 7.6 QUALITY OF DISCUSSIONS

%s of subjects
Bases = 40, Generation
85, Evaluation

Opinion held (Compared with face to face situation)	Predominant characteristic: Generation	Predominant characteristic: Evaluation
More satisfied with meeting	30	29
More task oriented	50	54
Less time consuming	42	31
More contribution by self	10	20
More control of direction taken by meeting	20	24

7.3 Implications

The main finding, which runs contrary to much of the literature on teleconferencing, is that the competitive meetings are most improved by being held over the system. This underlines the advantages of this research strategy which, instead of considering any difference or divergence from face-to-face meetings as being necessarily bad; asked the participants for their opinion. People used to holding decision making meetings are often aware that face-to-face competitive meetings have room for improvement. Instead of finding that people would not tolerate a system which has any effect on the structure or atmosphere of a meeting, the research shows that there is some support for a system which improves the meetings. Participants realized that such meetings are in fact more task oriented and also less restrictive. Colleagues can effectively show their approval or disapproval of an opinion without this criticism being taken personally by the particular proponent.

8. EXAMINATION OF MEETING PROCESSES

The preceding chapter considered the impact of teleconferencing in general on decision making tasks differentiated by their outcomes; contrasting the competitive with the cooperative and looking at tasks where the generative or the evaluative stage is more important. When the series of longitudinal studies was planned, it was decided that these outcome oriented tasks should be augmented by tasks aimed at discerning the processes of group decision making under teleconference conditions. Two specific tasks were employed for this purpose. The first is concerned with changing the opinions of others and, as described earlier in this report, it is the source of a notable counter-intuitive result concerning teleconferencing. The task and methodology, developed by Short (1972), selects an item of opinion on current life on which two experimental participants disagree. They are then set to discuss the issue with the instruction to reach agreement within a certain time. The experimental variable was the medium of communication by which the discussion was held, and the counter-intuitive result was that opinion change was more marked in teleconferenced discussions than in face-to-face discussions.

The task had not previously been used in four-person groups, and so had to be adapted to suit this purpose. Also the general research design was not aimed at comparing the results of teleconferenced meetings and 'control' face-to-face meetings. The purpose of using the procedure was thus exploratory rather than an attempt at confirmation.

The second task reported in this section also gained prominance through its production of counter-intuitive results. The 'risky-shift' phenomenon was reported by Stoner (1961, 1968) following research in which groups discussed the advice to be given to a fictitious character faced with a choice of two alternatives likely to affect his or her whole life. The choice was between a course of action which was safe and secure, but not very rewarding, and an opportunity which offered high rewards, but at a risk of failure and substantial loss. The advice was to be the level of confidence of success (expressed as a probability) which the character should have before following the more risky path.

Stoner's counter-intuitive finding was that comparison of the pooled opinions of individuals before and after holding a group discussion, showed that instead of increasing the conservatism of the recommendations

as had been anticipated, the discussion was found to encourage a more risky attitude. Further research with different types of decision problem revealed that the increase in riskiness was a function of the problem. Sometimes the movement was indeed towards greater caution. However the most common finding was a general movement towards extreme attitudes rather than moderation.

The term 'risky-shift' was replaced following this further work, by the description "enhancement of dominant attitudes" (EDA). EDA suggests that a dominant opinion amongst the group pulls the attitudes of others toward and even beyond that opinion. In instances of crisis decision making, the possibility of one dominant opinion producing a strong swing toward either extreme risk or extreme caution may need to be guarded against. For this reason it was decided to include some of the discussion topics used in the EDA research as tasks in teleconference sessions, to examine the nature and movement of any attitude shifting processes.

8.1 Attitude Change

The two aspects investigated here are temporary individual concessions which may allow a group decision to be made, and the more long term internalization of opinions, where personal attitudes are maintained even after the meeting has finished. In this task, it is necessary to decide upon a level of agreement (or disagreement) with each of a series of contentious statements (see Annex B). The initial opinions of the individual group members were recorded at the start of the week on 11-point scales (from 'strongly agree' to 'strongly disagree') on each of 19 opinion statements concerned with issues in present-day life. These initial opinions were subsequently compared with the agreed opinion of the group following discussion, and with the individual's own opinions measured again at the end of the week of teleconferencing.

The initial set of questionnaires are examined for those statements on which the group members have different levels of agreement. These are then chosen to be discussed during the week. Four types of division were distinguished between the members of the group. These are shown in Figure 8.1 with the experimental results. Type A is the closest parallel to Short's original research paradigm, with two highly divergent views

being equally pitted against each other. The difference is that there are two people expressing each of the opinions. This potentially represents the hardest split to reconcile, with each participant able to draw support for their opinion from an ally.

The second type of division (B) typifies those occasions when one person is standing out from the main feelings of the group. In these circumstances it has been found in face-to-face meetings that pressure and attention is focused on the lone divergent group member. The other two types are concerned with more diversity of opinion in the group. In type C two participants with oppositely extreme views are separated by the 'moderate' opinion-holders, whereas in type D we again have an imbalance with two people at one extreme, against a single opponent, with one moderate.

The first finding of the sessions is that it may not be possible to reach a concensus opinion at all. Four of the discussions held under this paradigm failed to reach a conclusion, but this failure was not related to the type of attitude division. The remaining groups did reach a concensus opinion which naturally meant that some group participants had had to change their expressed opinion. Figure 8.1 shows the average movement along the eleven-point opinion scale, of the expressed opinions of group members in each of the division types. Mean attitude change is shown for both the time immediately after the discussion, and at the end of the week of teleconferencing. The smallest average opinion changes arise in those meetings in which three participants hold one view contrary to the fourth participant (type B). The typical outcome is that this fourth person comes into line with his colleagues, who might concede only slightly to his argument. Hence the average recorded movement is small as only one person has substantially changed their position.

FIGURE 8.1 CHANGES OF OPINION ALONG THE SCALE OF AGREEMENT OR DISAGREEMENT

Type	Divisions of group	No. of discussions	Average movement over discussion	Average movement over week
A	2 : 2 (2 against 2)	5	3.2	1.29
B	1 : 3 (1 against 3)	5	2.06	1.25
C	1 : 2 : 1 (1 against 1 with 2 moderates)	5	3.56	1.87
D	2 : 1 : 1 (2 against 1 with 1 moderate)	5	3.75	2.94

It may be assumed that the attitude change of the single divergent opinion holder in the type B divisions, is primarily that of compliance with the group norm under concerted pressure from other group members. Such an effect would be expected to be temporary and to also apply to varying extent in other divisions. That this may be so is supported by the much lower levels of attitude change recorded over the week as a whole. Any concession made to the discussion is not fully accepted into the individual's own personal attitude set.

By way of contrast the type D distribution, with two extreme opinion holders on one side matched against an opposite extremist and a moderate, produces the greatest average movement both in the course of the discussion and sustained over the week. As the second highest level of change occurs in the type C distribution, which also has the moderate influence, it may be reasonably assumed that these moderates encourage not only temporary concessions, but also more sustained internalization of the opinions expressed in the discussion. The discussions of types A and B, in comparison, may produce temporary concensus, but they cause little real change in personal attitude.

The role of a 'middle ground' opinion in these discussions is not clear, however, since the derivation of an agreement is not always the result of averaging the opinions of group members to produce a solution acceptable to all sides. In some instances of types C and D discussions, the final 'agreed' group opinion coincided with that of the solitary

'extreme' opinion holder. Hence the influence of the group 'moderate' is not always to produce moderation.

8.2 'Risky-shift'

Four discussion tasks were provided to teleconferences during the week. Three were taken from Kogan and Wallach's (1964) choice dilemmas questionnaire and are typical items used in demonstrating risky-shift. A fourth item was included of a slightly different kind in which the probabilities remain constant (whereas they vary in the three other items), but the magnitude of the capital at risk and the reward are varied (see Annex B). Subjects were asked to read the instructions carefully and to indicate their individual choices on the questionnaires. This was done with no teleconference link between the subjects. After completion and collection of the questionnaires they were then asked to discuss the item as a group and come to a mutual agreement. They were instructed not to discuss individual estimates but to discuss the topic as freely as they liked.

The results in terms of acceptable probabilities or capital risk were then recorded on a 6-point scale, with values ranging from very risky at the low end to very cautious at the high end. For each item individual answers were pooled and averaged for comparison with the post-discussion group answer. A summary of these results can be seen in Figure 8.2, averaged across tasks.

As can be seen neither risky-shift nor cautious-shift was demonstrated in the teleconference sessions.

FIGURE 8.2 SUMMARY OF RESULTS OF RISKY-SHIFT TASKS

	Average individual pooled scores	Group scores	Average risky-shift
GROUP 1	3.5	3.75	-0.25
GROUP 2	2.875	3.0	-0.125
GROUP 3	4.2	4.15	+0.050
GROUP 4	3.25	2.75	+0.50
GROUP 5	3.75	3.75	0

\+ means risky-shift
\- means cautious-shift

Risky-shift in the past has been demonstrated in fairly rigorous experimental conditions. That is to say, large numbers of subjects were involved, many repeated measures were taken and thus, powerful and sensitive statistical tests could be employed to demonstrate the significance of the effect. However, we were unable to use such methods on results from only 5 groups and 4 discussion tasks. It is, therefore, entirely possible that the effect, if not a large one, would be undetected due to the limited sample space.

8.3 Implications

Although based on only 20 discussions the results on attitude change do suggest that:

- a group concensus is usually reached, indicating that quite large attitude changes can be provoked by the need for uniformity of opinion;
- such changes of attitude that occurred were short term and thus not strongly internalized;
- the presence of moderate opinion-holders between extremists tends to catalyze attitude change, although the moderate opinion may not itself be the focus of such movement.

The investigation of risky-shift was inconclusive, and a much larger subject base using a full version of the choice dilemma questionnaire will probably be necessary to decide whether risky-shift remains a significant feature when discussions are held by teleconference. Most risky-shift work has been carried out in the U.S. but Champness (1972) used British subjects on a video teleconference system with modified choice dilemmas, and was unable to show any significant effect.

As it stands, the only valid conclusion that can be drawn is that teleconferencing does not encourage groups to take decisions which are extreme in either the direction of risk or of caution.

9. TESTING GROUP DECISION ENHANCEMENT FACILITIES

9.1 The Private Audio System

The use made of the private system, whereby any two participants may communicate without being overheard by their colleagues, varies considerably from group to group. The level of use is task dependent, yet is very unpredictable even within a particular group of similar tasks. This is partly due to the form of the system's introduction. Corresponding to the project's brief that a system should need little introduction, participants are told very briefly how to use it, but not told possible reasons for using it. Thus as a novel facility, its use is very much up to the wants and imagination of the individuals concerned. This is illustrated by the wide range of uses invented by groups attending the sessions, e.g.:

- The confirmation of an idea's validity with a colleague, before presenting it confidently to the group as a whole. An example was where a relatively less expert participant was afraid his own opinions may have been inappropriate.
- A brief private appeasement of a colleague's feelings, subsequent to a harsh public disagreement. In such a way, group spirit was maintained, within a time conscious and task oriented discussion.
- Coalition formation, or a private agreement of a line, which two people believe should be adopted by the group. United, such a pair often may dominate the direction taken by a discussion. This is clearly advantageous within a logical deliberation, where the changes will be adopted only when proven to be valid. Otherwise it may be an example of how personalities may override and impair the decision outcome.
- The independent collection of opinions by a chairman, before publicly declaring the concensus of opinion.
- The passing of jocular remarks between individuals.
- Especially during the longer discussions which have been held, the system has been frequently used for the formation of subgroups. These may decide upon, or calculate, some portion of a large task, without disturbing the whole group.

> In many meetings, all participants may be wastefully involved in every aspect, however trivial, of the business in hand. It may be decided that the meeting be adjourned, while those parts of the problem are completed, or alternatively that a subcommittee withdraws to another room. However, in both cases, the waste of time and effort involved can be reduced using a teleconference private link.

These are examples of benefits which may be enjoyed without interference with the general trend of the discussion. A specific example was of a three tiered meeting, consisting of the head of a Civil Service department, the leader of one section within this department and two of his subordinates. In this real two hour meeting, the section leader was better able to coordinate privately his subordinates' wishes and opinions on issues, as and when brought up by the department head. He, meanwhile, was able to chair and brief the meeting as to their roles for the following year, without any overt loss of dominance to his immediate subordinate. This arrangement was found very satisfactory to the head of department, the section leader and his personnel. In comparison with their normal meetings, all were pleasantly surprised by the speed and ease of the meeting.

For the last 27 sessions when the private system was made available, a microcomputer logged any use made of the equipment. This information is summarized in Figure 9.1. Each call refers to a one way passage of speech and a fully communicating dyad will thus require two calls, one returning from the second participant. During the more cooperative tasks the system is likely never to be used. The highest levels of use (47 calls in a two hour session) were recorded from competitive tasks, in which two subgroups were set up. Each agreeing privately the line to be adopted by their coalition. If at any time, a third participant tried to access the system, while two people are already using it, his red 'engaged' light came on. Occasions when this occurred were almost all during those few times when there was most use. The calls to the controller consisted of requests for aid or information, or simply to indicate that the meeting had concluded.

FIGURE 9.1 USE OF THE PRIVATE SYSTEM

Base = 27 sessions

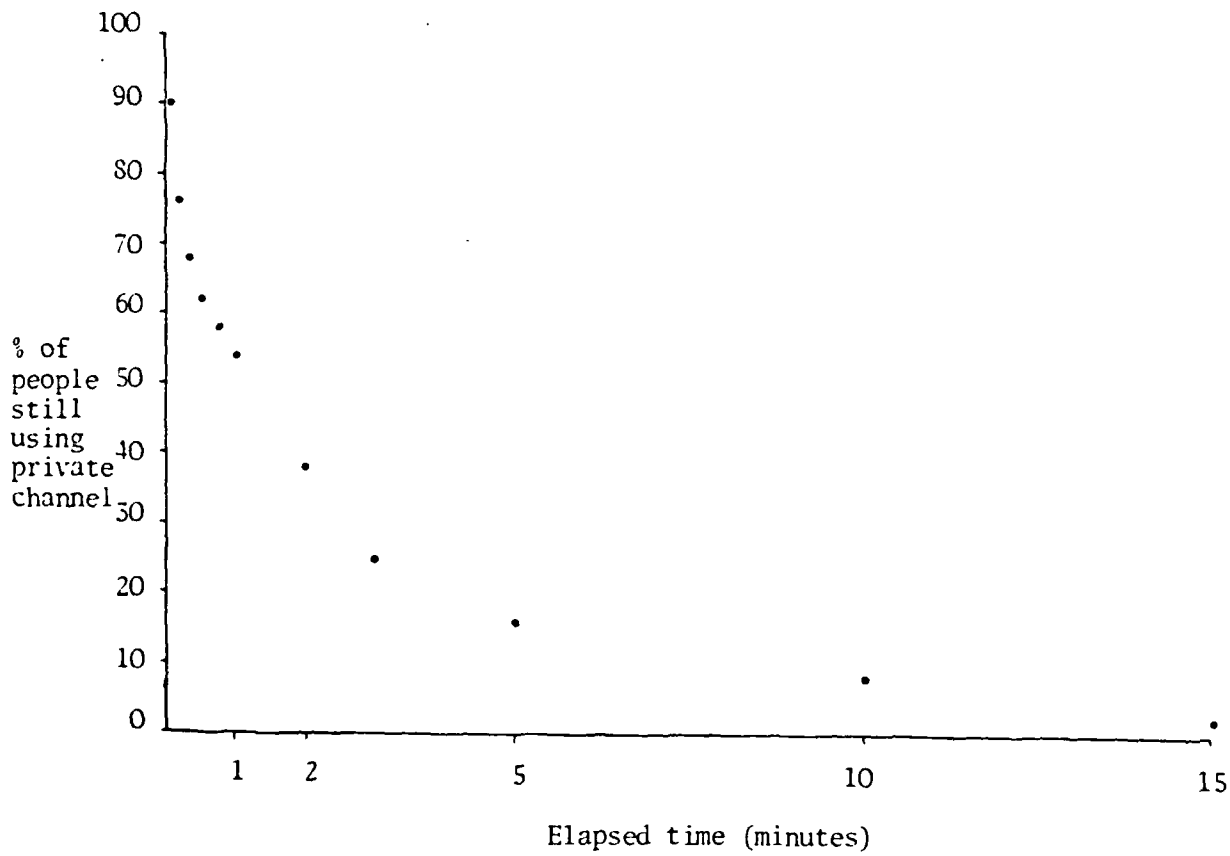
	Total number	Average duration	Average no. /session	Range of use /session
Private participant to participant calls	190	2 min. 40 sec.	7.0	0–47
Private calls to controller	98	18 sec.	3.6	0–10
Occasions when system already engaged by others	47	-	1.7	0–18

More information about the duration of private calls is shown in Figure 9.2. 24% of calls are over very quickly, within 10 seconds, the remainder being most likely to last up to 3 minutes. A third small category of calls may take much longer, 2% taking over 15 minutes. These categories reflect three main types of communication:

- a very brief comment on the main discussion
- a clarification of some aspect of the meeting
- the setting up of a subgroup or a further select meeting.

There are still emotional constraints upon the system's use. Colleagues have apologized for, and subsequently explained, the drift of their private withdrawal from the group discussion. This lack of trust associated with people's use of the private system, is especially marked when two subordinates exchange views. It may be so great that the meeting waits until the private conversation has finished. However, the numbers of such complaints only make up a very small minority of the total occasions when the system was used. Certainly, in larger groups, one would expect this distrust to diminish, as the number concerned in each dialogue becomes a much less significant proportion of the total group. An additional facility which may make it more agreeable to the senior chairman would allow him to interrupt a long private conversation and reconvene a meeting. A few occasions arose when the main discussion suffered whilst a privately communicating participant was required to contribute to the group as a whole.

FIGURE 9.2 DURATIONS OF PRIVATE CHANNEL USE



In the system's present form, a third person may detect a private remark or conversation since he will see the speaker's lips moving whilst not hearing any associated speech. The private system may be made more 'invisible' if at the same time someone accesses the system, his visual image is replaced with a recorded replay of his last few seconds' non-speaking attitude. However, whether this would reduce dissatisfaction is not certain. Many people feel they would be more distracted wondering if someone else is privately communicating than seeing someone's lips move and not hearing what he or she is saying. The whole issue may be nullified anyway if a slow scan or degraded image is used, whereby small lip movements are unobtrusive.

The levels of unprompted use found, and the favourable comments received, do show some need for this facility. However, we are unable to show any measurable benefit gained from having such a system available (see Figure 9.3). However, because the private system is less often used during the cooperative tasks, which are the ones most easily evaluated, proper justification of the private system is not possible. Furthermore any use made of the private system was felt generally to be most worthwhile during the more complex competitive tasks. Use during the cooperative tasks arises partly from curiosity rather than from a wish to improve the decision outcome.

FIGURE 9.3 COMPARISON OF PROPORTIONS OF 'BETTER' AND 'WORSE' GROUPS USING THE PRIVATE AUDIO SYSTEM

	Private system used (Total of 4 groups)	Private system not used (Total of 11 groups)
	(Proportion of groups)	
Better groups (Base = 8 groups)	.25	.75
Worse groups (Base = 7 groups)	.29	.71

9.2 Chairmanship

In one series of trials, various participants' different perceptions of the preceding meeting were examined with particular reference to chairmen. These chairmen were either chosen at random by the controller or were allowed to evolve independently during the course of a meeting. Due perhaps to the recruitment campaign being biased towards the larger hierarchical companies or government departments, this emergence of a particular leader always took place within the first few minutes. This was true even if the participants had not met before and were from different organizations.

The overall effects reported by this series of groups with clear chairmen were:

- the meetings are felt to be as, or in many cases more, task oriented than people's expectations of a similar meeting held under face-to-face conditions;
- the meetings are similarly felt to be as or less time consuming;
- the pattern of these meetings can be extremely radial, the majority of the proceedings being mediated by a central chairman.

Similarly these participants themselves feel:

- they are as, or slightly more, satisfied with a teleconference meeting;
- overall that their own level of contribution is slightly reduced;
- that others present appear more cooperative, friendly and less aggressive compared to normal.

Thus one may conclude an apparent improvement and greater structuring of the decision making process, reducing the time consuming non-task oriented side talk. The greater impersonal aspect is compensated for by an attempt to avoid signs of negativity or animosity.

The greater structuring of the meeting about a chairman may be reflected in the comparison of the chairmen's views with their

colleagues. As shown in Figure 9.4 the chairmen are more likely to give positive answers on all questions, including those which implied some criticism (i.e. "the equipment was distracting"). The results are summarized below:

- Significantly more chairmen felt that the others at the meeting were less aggressive than normal.
- A higher proportion of chairmen felt they had more control over the direction taken by a meeting. Correspondingly their colleagues felt themselves to have slightly less control compared to a similar face-to-face meeting.
- A higher proportion of chairmen felt the other participants to be more cooperative than normal.
- Chairmen felt no lessening of inhibition on their part. Yet the most junior participants did tend to say they were less inhibited by others at the meeting. This view is supported by the observations of their colleagues, remarking on a naturally quiet person responding more.
- The meetings are nearly always referred to as being more democratic.

This last finding is not necessarily in conflict with an impression that the acknowledgement of a chairman was felt desirable by all the group members in the decision making meetings. Such acknowledgement was not within a personal dominance hierarchy with all the associated feelings of inhibition. Instead there was more democratic ccoperative atmosphere independent of the meeting structure which was task oriented, rather than person oriented. The strengthening of a radial structure accompanying hightened attention to task was, however, interpreted by the chairmen as a personal commendation.

The research attempted to divorce this task oriented structure from the most dominant senior member. This was done in two ways. Firstly, one person was chosen at random to be either chairman, responsible for the coordination of the meeting, or secretary, responsible only for reporting the group decision. Secondly, the electronic potential of the equipment was used to give unequal control of the system to one person.

FIGURE 9.4 COMPARISON OF OPINIONS HELD BY CHAIRMEN AND THEIR COLLEAGUES

Opinion held	Chairmen (Base = 9) (Proportion of people)	Others (Base = 25) (Proportion of people)
Others are more cooperative	.78	.44
Equipment is helpful	.67	.60
Others are less aggressive[1]	.67	.20
Meetings less time consuming	.44	.48
Meeting is more task oriented	.44	.36
Equipment is distracting	.44	.20
Meeting is more satisfactory	.44	.16
More control over direction taken by the meeting	.44	.12
Less control over direction taken by the meeting	.11	.16
Others appear more friendly	.33	.32
The visual image is peculiar in some way	.33	.08
Less personal contribution	.22	.12

1. Probability that the null hypothesis (that there would be no higher frequency of favourable remarks from the chairmen) is true is < 0.05 on a one tailed Fisher test.

The appointment of someone as chairman was respected by his colleagues. There was never any attempt to threaten this position. This result may be partly due to the fact that all participants are competent people, who are used to taking part in ordered meetings where the role of chairman is well-defined. The appointment of a secretary had no effect upon the structure of the meeting, which remained radially arranged around a central chairman. Chairmanship was still allocated according to rank or dominant personality, whilst the secretary would often be the most time conscious participant, generally hurrying the decision making towards the end of the meeting.

The second approach was to attempt to manipulate chairmanship by giving one, randomly-selected, group member use of the private audio switching unit. Hence he or she could talk privately to others in the group, but they could not return comments privately, nor could they establish private conversations with any other members of the group.

When this facility was given to just one person, its degree of use was determined by the role of that person within the meeting structure. In particular, when so presented, the private system was little used and then only when the operator was also the chairman. Possession did not necessarily result in that person also becoming the chairman.

One can conclude that the meetings are generally perceived differently by the chairmen. This is confirmed even when the chairman has been selected randomly by the research team. It would thus appear that the critical factor here is the role itself and not any tendency for that person to have a certain personality. Furthermore, this role is more than just acting as the focus of communications or being responsible for making sure a successful outcome is reached within the time scheduled. Amongst the personnel who took part in the research, there is a need for someone to adopt the well understood role of chairman.

9.3 Store and Forward Capability

In group discussion of a problem it is often the case that ideas are generated, but are never input into the meeting. This is particularly prevalent when the ideas involve novel solutions to the problem in hand.

There are two ways such ideas can be lost prior to input. Firstly,

the moment an idea is voiced may be sufficiently delayed that it is no longer relevant to the context of the discussion. In normal meetings such ideas and thoughts are jotted down on paper in the form of a few connected keywords, but often such notes are unintelligible later on, or at least lack the impetus of the initial thought. Under the conditions of separation of a teleconference, some capability could be introduced to permit participants to communicate indirectly as well as in real time. In this way an idea could be spoken at the time of thought, but stored for input to the meeting at a later and more appropriate time. Control over the timing of input could be exerted by the conference controller or by the participants themselves.

Secondly, ideas may be edited out by their initiator. This process, a particular problem with novel ideas, is one of prejudgement and comes about through fear of negative criticism. Part of the solution, as discussed above, is to offer to group members the opportunity to sound out their opinion using the private audio system. However, another solution may be to offer teleconference users a method of input to the meeting which is disassociated from themselves - anonymous input. Ideas and comments could be transcribed to provide anonymity and displayed direct to all participants over the graphics display monitor.

In keeping with the philosophy of the project these two concepts were suggested in discussions with teleconferees before a non-technical implementation was made. Reaction to the concept of a storage facility was good - users said they speak their ideas more fluently and rapidly than when writing them down. This would mean they could attend to the ongoing discussion more fully. On the other hand the concept of anonymous input was received negatively. It was widely felt that the credibility of an argument would be lost if no name was associated with it. It was therefore decided not to proceed with an attempted implementation of anonymous input.

Implementation of the store and forward facility failed. Two methods were tried; direct speech input to a tape recorder, and written text.

At the first level of implementation it was not practicable to provide each participant with the capability to directly access the store-and-forward voice system. Instead they were required to call the

session controller over the private audio system and request use of the system. The controller then connected their private audio call to a tape recorder input, so that they could record their message. The play-back of the message to the whole group was instigated by the controller.

The facility was not used at all in this form. It was concluded either that any advantages of voice recording for idea storage in the teleconference investigated was not strong enough to warrant following the procedures specified, or that the inhibition of recording a message "blind", for replay in an undetermined situation, was too great. To simplify operation several sessions were run in which participants were told that if they wanted to make any ideas or comments without disturbing the flow of the conversation, they should note them on paper and inform the controller by pressing the 'speak to controller' button on the private audio system. The controller would then collect the written comment and display it on the documents monitor. While this system of implementation has the same problems as self-prompt notes in terms of clarity of interpretation, it was thought that it might aid the input of an idea to the meeting.

In application it was found that participants did not see any advantages of this system compared to making notes for their own use.

9.4 Information Retrieval

One of the concepts put forward in the initial proposal was that support staff outside the meeting itself could provide services such as retrieving and displaying information needed in the meeting. The usefulness of information in decision making meetings depends very much upon the amount and complexity of the material. On the one hand too much information will cause overload, with effort being diverted to searching through irrelevant information whilst inadequate information frustrates the decision making and may provoke postponement or guesswork.

There is a distinction between information used in making a decision and information available to meeting members. One of the reasons for considering information availability in decision making was not the direct value of such information to the discussion, but the indirect effects on the participants themselves. Information is seldom equally enjoyed by everyone in the meeting. It may be unevenly distributed as a

result of specialized knowledge or selective access to specific sources.

Classical social psychological research has shown that distribution of information is linked to influence within the group. One of the reasons for the pressures on individuals to conform to majority opinion is centred upon information distribution. Individuals are often dependent upon the group as a whole as a source of information and it has been shown that a lack of personal information can encourage conformity. In contrast, individuals who have access to large information resources have greater influence over the direction of the discussion, are held in high esteem by the rest of the group, and gain readier acceptance and stronger approval for their opinions.

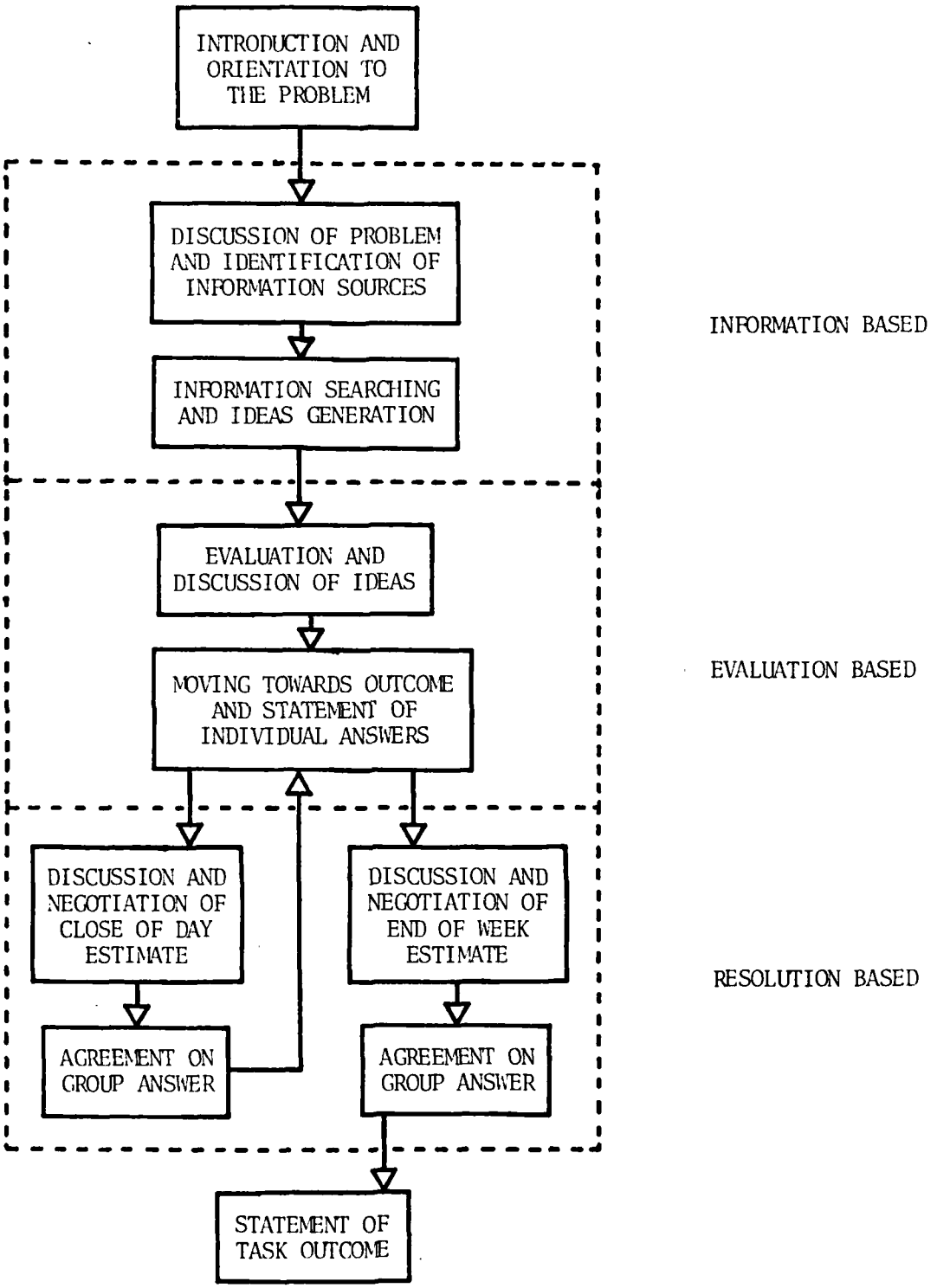
This area of the research was therefore concerned with the access to relevant information in such a way that availability could be pre-structured. It included the equal distribution of complex information, the availability of information to group members from a central location, and the deliberately uneven distribution of information.

The use of information within the group is best appreciated from an understanding of the structure of the meeting processes and the part played by information at different stages in the meeting. Figure 9.5 shows the average flow of the meeting for the 40-minute discussion of the Financial Times Index. This meeting structure was typical and was identified from analysis of tape recordings of the meetings. The three main sections identifiable were:

- information based
- evaluation based
- resolution based.

While these sections were rarely discrete they were usually distinguishable. The information based section usually followed a short period of orientation to the task and was dominated by the assimilation of information and the generation of ideas. Once a sufficient amount of information is gathered the emphasis of the discussion moves to evaluation rather than assimilation. The outcome of the second stage is usually the individuals' own conclusions or answers to the problem. The final stage is then concerned with achieving a single outcome acceptable to all members of the group.

Figure 9.5 TYPICAL MEETING FLOW FOR THE 40 MINUTE F.T. INDEX DISCUSSION



In analyses of meetings with good and with poor outcomes, the noticeable difference was not the experience or ability of the participants, but the relative emphasis upon the process stages of the meetings. The meetings which emerged with the best outcomes had relatively little emphasis upon information assimilation, whereas those meetings which involved a protracted information-based section resulted in poor outcomes.

In meetings with a long information-based stage, too much time and effort was spent in assimilating and discussing the information with severe consequences for the evaluation of solutions and hence the outcome of the meeting. Those meetings which emerged with good outcomes generally spent only a short time assimilating information; discussing only those items of information which seemed most pertinent. The emphasis here was on the quality rather than the quantity of information and the group was not worried by the possibility that potentially relevant items may be neglected. It should be remembered that the task under consideration, the estimate of the Financial Times Index, is simple in structure yet the amount and variety of information which can be brought to bear upon the problem is very considerable. The task was also bound by a relatively short time period: 40 minutes.

It is clear that the consequences of information overload can be disastrous, and the amount of information presented to the meeting participants must be controlled.

In the course of the project, investigation of information retrieval has focused on the documents display and associated ergonomic factors. The combinations used have been:

- switched self-view/documents monitor, or
- dedicated desk-top monitor, and:
- display to all members, or
- display to one person only.

Conclusions on the preference of displays of information are based upon user comments after teleconference sessions and upon observation of users by members of the research team. The presentation of information on the self-view/documents monitors was universally disliked. This was not due to the switched mode of access, but to monitor-participant distance.

Users of text or graphic information prefer to have the information at arms length. The viewer-monitor distance for optimum picture vision based upon resolution and picture size does not hold for text and graphics display. Perhaps because of the vastly reduced tonal content of such pictures, the viewer accepts the perceptable line structure for the sake of a familiar reading distance and the ability to closely scrutinize fine details.

In requesting information users rarely asked for it to be displayed at their station only. When this did occur it caused little distraction or enquiry and was found to be a useful facility, even if rarely used, in that group members felt able to work with a document while some other topic was discussed.

The relatively low level of personal use of information retrieval may be associated with the tasks, which placed all members of the group in an equal position, with equal ability to tap the information sources. In meetings where knowledge is unevenly distributed (e.g. through the use of specialist advisors) there may be greater requirements for information as a validation.

9.5 Implications

The private audio system appears to be a useful facility, but only for a proportion of teleconference participants and meeting types. An alternative would be to have the setting up of private calls mediated by a meeting "producer" or personal aide. The disadvantage here is that since a quarter of the calls were brief comments, taking less than ten seconds, a significant loss of spontaneity will result, and is likely to inhibit this proportion of calls.

The use of a stored voice capability to provide 'time of thought' input may have some potential value but this value is only likely to be realized in longer, more complex meetings, and then only if an easier means of operation can be developed. The concept of recording out-of-context ideas for later replay to the group may seem artificial to users, especially if the timing of presentation is not under their control. But then the function of such recordings as an aide-memoire may be lost if an appropriate replay of the tape depends upon remembering its contents. Alternative ways of feeding back the information to group

participants will thus need to be investigated.

The notion of providing an anonymous input to a meeting was not found to have any real support. The criticism was that of lowered credibility in any comment made anonymously, but it must be remembered that this prevailing opinion has not been tested experimentally. It would certainly appear that the private audio channels provide adequate opportunity for individual group members to express their ideas covertly rather than in open discussion. However, expectations are sometimes confounded and it may be that an anonymous input is of some use in the generative stages of certain meetings. For instance, when a suggestion is too outlandish for normal input to a sober discussion, or when inappropriate background or experience would in any case reduce the credibility of someone's idea.

As anticipated the use of information in group decisions is critical to the quality of the decisions made. The danger of information overload will be reduced if information has to be specifically requested rather than being available to hand. Individual (as opposed to group) use of information retrieval systems is likely to increase with a greater diversity of pertinent skills and knowledge among the members of the group.

The research on chairmanship in meetings shows that in task oriented teleconferences, there is an easier emergence of and acceptance of a chairman. The reported reduction in personal inhibition does not result in a lack of respect for the chairman nor a disordered meeting. Rather, the discussion is radially arranged about a chairman, who as a result perceives the meeting and his colleagues differently. This structuring is not caused by any dominance in the personality of a chairman, but emerges with the role.

10. TELECONFERENCING OVER LONG PERIODS

The study of teleconferencing over long periods of time was included as part of this program of research, when its importance and relevance were realized from comments made by users during the early phase of the research. Some aspects of long-term teleconferencing could not be effectively simulated, particularly those involved with actual geographic separation.

The location of all teleconference nodes in one building meant that it was not possible to stop participants from meeting face-to-face sometimes during the long-term sessions without recourse to complex and artificial scheduling.

This investigation of long term effects looked at both single meetings of longer duration (ranging from 40 minutes up to 4 hours), and sustained teleconferencing (involving many meetings over a virtually continuous period of up to a week). The objects of investigation were:

- group dynamics
- user fatigue
- medium and person perception.

The original 40-minute lunchtime evaluation sessions were supplemented by company meetings of longer duration. These meetings involved both CS&P Ltd. staff, clients or, in a number of cases, external groups. Management, client and project meetings were re-scheduled to be held over the teleconference system as were all meetings involving the project team. It should be noted that the project team members were using the conference rooms as office space. They were, therefore, using the system daily. Analyses in the early stages were purely subjective, involving a short debrief and questionnaire. Later in the project more objective measures were used as a complement.

This chapter examines two specific instances of sustained teleconferencing as case studies, and reviews experiments with groups coming in over one week.

10.1 The First Case Study

The first sustained teleconference involved four company staff who, in the course of their normal work, were engaged in a series of meetings. At times these meetings would need all four staff, but a large number of the meetings would comprise only a part of the group. In normal practice such a project would require arranging meetings in the company conference room, followed by periods of working alone or working in sub-groups when some convenient work space was available.

The staff were occupied over five days. They used the conference stations on the understanding that all interaction between group members, including graphics and documents transfer, would be via the teleconference facility or one of the operators. This arrangement of interlinked offices would provide an opportunity for both investigating behaviour and identifying the problems which will occur in long term sustained teleconferencing. The bonus here is that we are not involved in staged or simulated meetings, but are using staff members in normal work.

The pattern of the work included:

- project meetings - all group members
- sub-group meetings - involving 2 or 3 staff
- individual tasks.

Project meetings were held at the start and finish of the contract and at periods during the week as arranged by the project leader. Sub-group meetings usually concerned the performance of some specific group task, but also included short meetings for the exchange of information or the airing of a problem. Many such meetings occurred during the week.

Group Tasks consisted of:

- Information exchange
- Generation of work plans
- Problem solving
- Individual task allocation.

Some of the benefits of using the fully switchable teleconference system were obvious. Group meetings, sub-group meetings and individual

tasks could all be carried out in the same room. Simply by pressing a button a meeting could be arranged or terminated. This arrangement decreased wasted time during project meetings if a problem arose requiring one or two staff to perform some short task. They could then withdraw from the meeting simply and efficiently with little disturbance to meeting flow. The task performed, they could then return to the meeting with little time having been spent between the decision to tackle the problem and accomplishing a solution.

This means that within a teleconference with audio-video switching, characteristics of the meeting can change much more frequently than is possible in either round-the-table discussions or in unswitched teleconferences. Problems can be tackled as they arise rather than the customary procedure of noting them down for later action.

This overall change in meeting behaviour also caused problems which, while focused on the specific equipment used, do demonstrate a general difficulty in teleconference design. The problem areas were private audio switching, and text and graphics transfer.

In sustained teleconferencing, the use of the audio switching facilities for the withdrawal of an individual or sub-group in order to work separately, became markedly increased. Although an additional advantage, this was not originally envisaged as one of the primary uses of the switching system, which was seen more as a simple message transfer capability. It is therefore not surprising that in these prolonged sessions, some limitations of the private audio system that had not hitherto caused significant problems, should thus begin to raise difficulties.

The main problem with this equipment was that participants who were not in the public mode could not be called back into the meeting except through the controller. Thus individuals or sub-groups working separately could not be easily consulted and, in earlier sessions, chairmen were unable to contact group members conferring privately, in order to reconvene the meeting.

Comments were occasionally made that a private system communication might support three users, or that two private dyad links ought to be available at any one time. Although these suggestions may have some value

for the short conferral capability in competitive discussion tasks, they do not seem to be necessary for the group division involved in separate working. Specifically, the three person sub-group could be on public whilst the fourth member suppresses their discussion by releasing his "audio on/off" button. The same method of division could be adopted by two pairs of participants since the private system is unaffected by the "audio on/off".

Information transfer was also a problem experienced during this week. In a well-defined, pre-set task, it is not difficult to arrange for a high proportion of relevant material to be available beforehand. This can be distributed either as multiple copies or as a television image supplied by the controller. Alternatively, in a less structured, more open ended type of meeting such as those faced by the company staff in this case study, thumbnail sketches in the form of graphs, flowcharts or other diagrams were often dashed off by the participants in order to illustrate their remarks. Because the room cameras scan in reverse and do not have appropriate lenses to resolve fine detail, it is not practicable to hold these sketches up to the camera for the other participants to see. This means not only that there is a delay whilst they are collected by the controller for display from the documents camera, but also that they cannot now be added to or pointed at by the originator for the further interpretation of details. It can thus be appreciated some form of room-to-room "document" display or transfer would be an important additional facility.

A final experience which attended this long-term teleconference was not realized until sometime afterwards. In subsequent discussion with participants, three group members, individually and without being asked, remarked on feeling exhausted the day after the project was completed. This was to be investigated in subsequent long-term meetings. Analysis of the problem of fatigue is important in that the cause may be the teleconference system (e.g. four video monitors may produce eyestrain), or may result from the increased efficiency and attendance to tasks that seems to be elicited from users.

The first step of investigation is to test the hypothesis that teleconferencing is more tiring than normal working.

10.2 The Second Case Study

The next stage in the investigation of sustained teleconferencing again involved company staff in a real meeting.

This involved a 1 day conference of four company engineers. It was decided to use this group in a pilot trial of a simple perceptual/motor test used to detect concentration loss and fatigue. A matched control sample of company staff were also recruited to carry out the tests during the course of their normal work. The perceptual/motor test, a simple paper and pen exercise (see Annex B), was administered six times during the day - on arrival, at mid-morning coffee, before lunch, after lunch, in mid-afternoon and at the end of the day. Also during this teleconference a procedure of enforced agenda was applied to see whether such a system would be helpful or disruptive to the meeting. The teleconference consisted of two distinct meetings one carried out in each of the morning and afternoon sessions. Agendas were produced for both meetings but only in the afternoon session did the controller enforce it. The agenda enforcement was done visually using the documents camera with first a gentle reminder to move on to the next item followed later if necessary by stronger reminders of time and of where the group should be on the agenda.

The results for the perceptual/motor test are presented in figures 10.1 and 10.2. The relative speed of performance on the test reflects the general work-rate, while the accuracy indicates changes in alertness. Hence the two parameters are complementary indices of attention and fatigue. The two graphs show characteristic variation in performance: speed increases through the day in accordance with a gradual learning curve, while fatigue build-up produces an increasing error-rate except for the improvement following the rest break for lunch.

What is more notable is that the performance of the teleconference participants is consistently better than that of a corresponding group of CS&P employees, roughly matched for age, status and sex. Speed of performance shows more marked improvement during the day amongst the teleconference members, while their accuracy does not fall as rapidly.

As this is the result of a single case study, it would be inappropriate to draw firm conclusions. However, the measurement procedure

Figures 10.1 and 10.2 Comparison of Normal Working and Tele-conferencing on a Simple Perceptual-motor Task

Figure 10.1

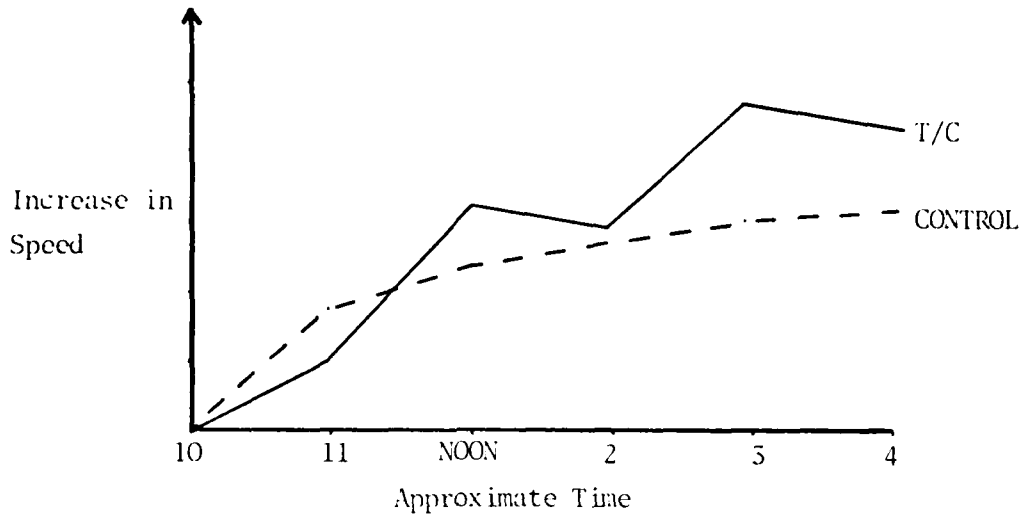
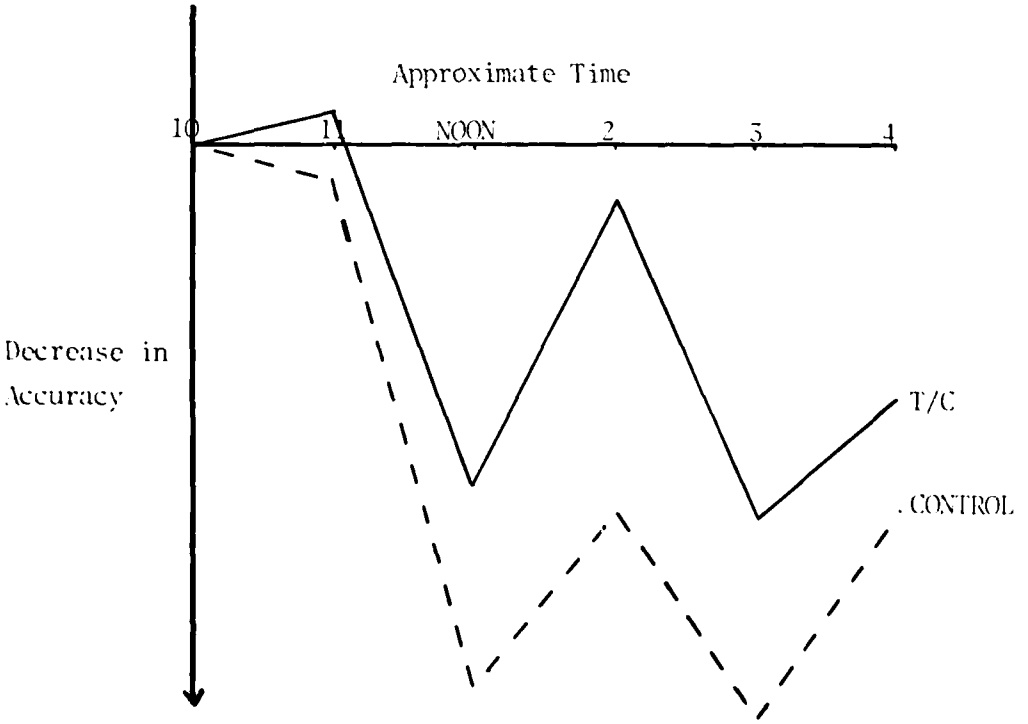


Figure 10.2



has been shown to be a valuable and sensitive index of fatigue and it has demonstrated that significant mental debilitation does not occur during sustained teleconferences.

The agenda enforcement was not found to be disruptive to the meeting under investigation. The meeting was more orderly and the group did make reference to the agenda when they realized they were overrunning. In the non-enforced condition the meeting overran the allocated discussion time by 50 minutes, while the enforced session overran less than 5 minutes. Comment from the group, however claimed that this was in part due to the nature of the second meeting. This subject warrants further investigation with more sophisticated and rigorous experimental procedures.

10.3 Experimental Studies in Sustained Teleconferencing: Research Procedure

Meetings involving sustained teleconferencing were carried out using temporary company recruits. All were graduates who used the equipment continuously, in groups of four, over four days. Five weeks of discussions were continuously monitored by two controllers, tape recordings and a microcomputer-based switching events recorder. This recorder monitored all use of the audio switching facilities offered to discussants. Discussion topics over the week covered a wide range of meeting aspects including cooperative and competitive problem solving, role-play and information exchange.

This research approach was adopted to further investigate teleconferencing over prolonged periods and to gather data on a wider range of discussion tasks than had been possible in the lunchtime sessions. The concern here is with the effects of sustained teleconferencing and other aspects of the performance on these tasks has been discussed in previous chapters.

10.4 Group Dynamics

None of the people involved in this series of teleconference simulations had met previously. They would thus have to evolve a relationship in circumstances which are unusual if not alien. To ensure that the research value of this situation is not lost, the arrival times of meeting participants were staggered so that the initial meeting would take place over the teleconference link.

During the five weeks, three conditions were used to investigate the effect of teleconferencing upon group dynamics. It should be remembered that inferential conclusions can only be drawn with strict reservations, as the results from a total of only 5 groups, and therefore 5 initial meetings, are available for analysis. The three conditions operated were:

- 1st discussion held in visual mode followed by coffee face-to-face
- 1st and 2nd discussions held in visual mode, participants have coffee while separated
- 1st and 2nd discussions held in audio-only, participants have coffee while separated.

The monitoring of the group dynamics was done using a simple questionnaire which sought details on participants' views on dominance, influence and contribution of all the individuals in the group. This was then repeated over successive sessions with participants redistributed amongst the rooms and, independently, with rearranged monitor positions.

Perhaps surprisingly monitor position was found to influence all three perceptions (of dominance, influence and contribution). The position at bottom right of the four monitors carried significantly fewer people seen as most dominant, most influential or as contributing most to the discussion (Chi-square statistic = 23.00, $p < 0.001$). This emphasizes the point that the influence of simple ergonomic factors should not be underestimated.

The concordance of opinion in the group on all three factors was generally high and better than had been anticipated. From the literature on the establishment of dominance hierarchies it would be anticipated that the disruption of eye-contact would affect the group's ability to establish such hierarchies. However, no evidence could be found for this hypothesis. In normal face-to-face meetings dominance hierarchies are fairly stable, often only changing in the face of some very influential event. However, the pattern formed in the teleconference meetings was for the dominance hierarchy to change from task to task. Although this effect should be tested much more rigorously than it was here, the pattern suggests that dominance propagated in a teleconference evironment may be concordant amongst the group at only a cognitive level, and is less

stable than in face-to-face interactions.

Concordance amongst the group on dominance itself, while not statistically significant, was less in the group which met for the first time audio-only. Agreement increased greatly for the group after they met face-to-face. Also, this particular group was noted as being totally task oriented during their first morning. They did not refer to each other by name. In fact, they did not introduce themselves until they met face-to-face at lunch. It seems remarkable that this group of people carried out a discussion task for 2 hours and referred to each other only by the letters A, B, C, and D, used to label the four rooms. In a later interview with the experimenters the participants agreed that meeting and working in a group without first being introduced nor being able to see one another was both unnerving and anxiety provoking. Controllers never introduced groups: this was left to the individuals. Such self-introductions did occur in all visually linked groups within the first few minutes. However the audio-only group felt "out of their depth" as if they were ill-equipped socially for such an experience.

10.5 Fatigue and Concentration

The perceptual/motor test discussed earlier was used here to monitor fatigue and concentration over the whole week of meetings. One of the problems to emerge from the earlier work in the first case study was the possibility that sustained teleconferencing is more fatiguing than normal working. If this is correct then associated attention and concentration loss should be reflected in this exercise.

The specific test used in the second case study required validation over a longer period to try and go beyond the learning curve and reach a less ambiguous performance pattern of fluctuations about a roughly asymptotic level. A long learning curve would unfortunately create confusion between improvement through learning and deterioration through fatigue. Previous research with the specific test adopted here (identifying random substitutions in a page of uniform characters), while not used in a rigorous environment, found that performance level reached an asymptotic value after only 2-3 trials. Furthermore, a diurnal cycle was established in which a good morning performance generally falls off, with a recovery after lunch and another upturn near the end of the day.

Figures 10.3 and 10.4 Comparison of Groups 1-4 and Group 5 on Perceptual-motor Task (First Day)

Figure 10.3

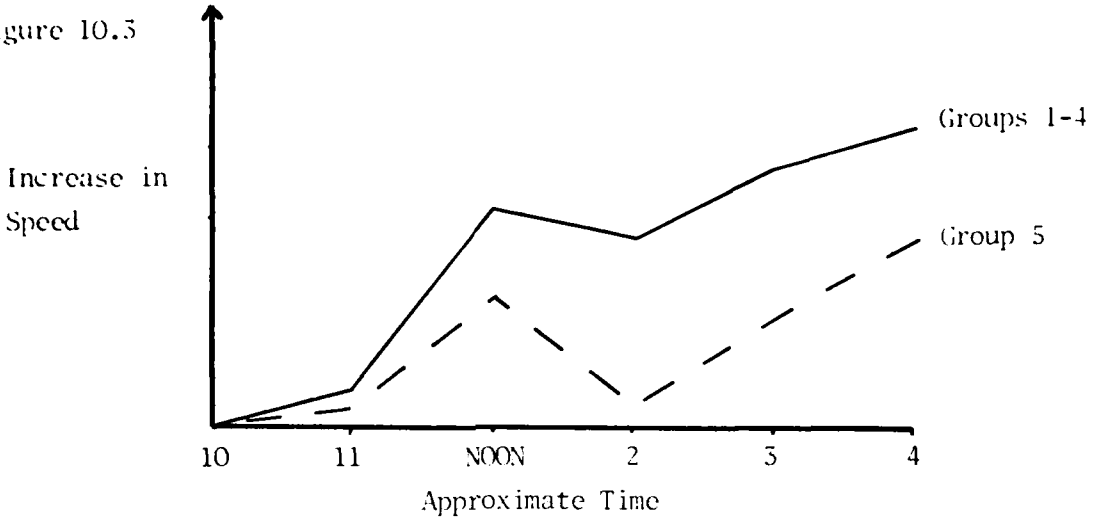
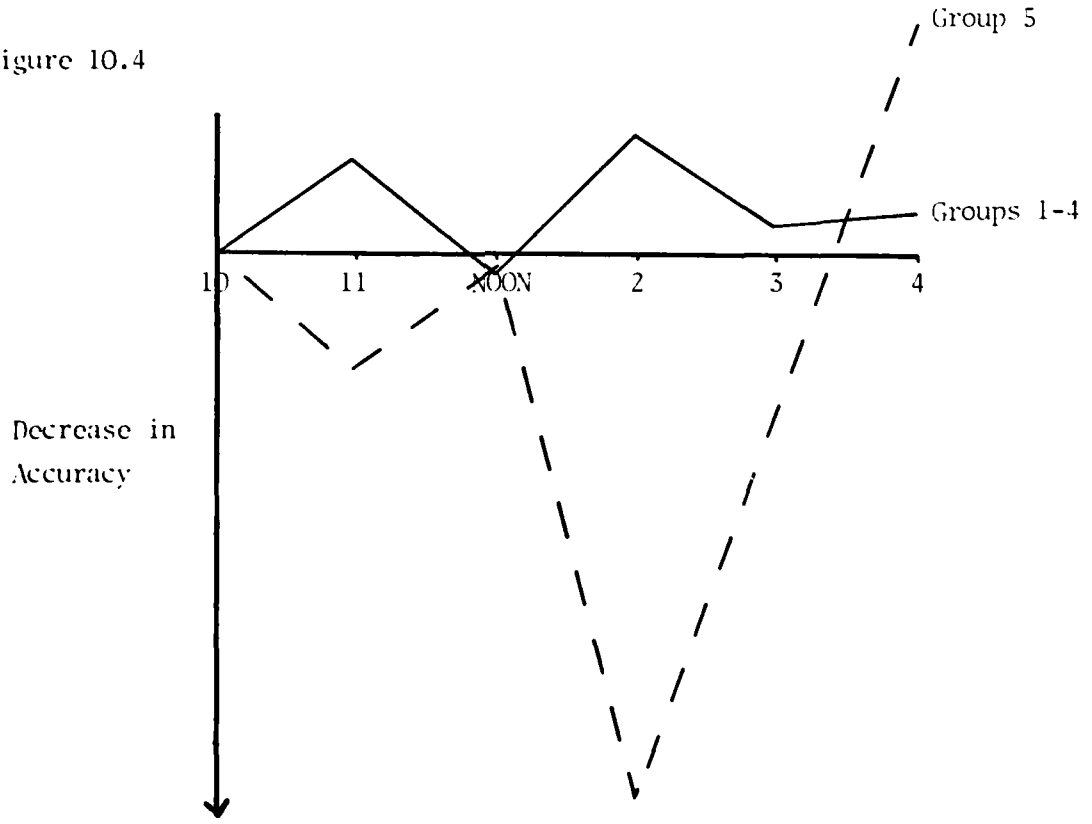


Figure 10.4



The performance of both the teleconference group and control group in the 2nd case study display this pattern of performance. The learning curve is reflected mostly in speed scores, whereas the diurnal cycle is seen in the accuracy of performance (see figures 10.1 and 10.2). Similar patterns of performance are distinguishable on the first day with groups 1 to 4 in the week long teleconference sessions (see Figure 10.3). What is notable is the disparity between all these groups, which involved strangers meeting over a video system; and the pattern of performance displayed by group 5, where strangers met over an audio-only system. The latter group made many more errors at the start of the afternoon and showed a greater loss of speed (see Figure 10.4).

Two possible reasons for this fall-off after lunch are that individuals may have been distracted after meeting face-to-face, or that they may have relaxed or been fatigued after an anxious morning.

At present, and without further research, it is not possible to make further inferences from this result. However, it should be stressed bring together strangers in audio-only conditions, seems to be more problematic than when visual contact is also provided.

Some attempt to identify the interference of learning effects in the perceptual/motor tests was possible by omitting them on day 2 for one group. Given the general improvement in performance over the three days, if on day 3 the results from this group were comparable with the average of the others, this will indicate that the role of learning is no longer important after the first day. Correspondingly, if the learning curve is long and performance is heavily dependent upon practice, then the group that missed day 2 tests will yield results on day 3 that are similar to, or worse than those of the other groups on day 2.

Aggregate scores were used for this estimation, which combine both speed and accuracy on the test. The pattern obtained, whilst generated from a very limited data-set, does suggest that the improvement in overall performance on the third day, compared with that on the second, is not markedly due to learning effects.

From these results, and from discussions with users during debriefing, we tentatively draw the conclusion that fatigue associated

with long term teleconferencing is not a direct influence of the medium, but arises indirectly from the greater task orientation of the meeting. This process encourages users to work harder and more efficiently and is hence in accordance with fatigue becoming evident at the end of long term teleconferences.

10.6 Medium and Person Perception

The questionnaires, discussed generally in chapter 6, were analyzed for changes over the first three days of teleconferencing. The results are presented in figures 10.6 to 10.9. Some of the effects of time on these opinions are indicative of adaptation to teleconferencing. The net reported changes in perception were:

- A decrease in number of conferees who see teleconferencing as less time consuming.
- A decrease in number of users who say the image is peculiar.
- A decrease in number of users who say the meeting has a strange pattern.

Two more pertinent results are the perceptions of the others where:

- others are seen as less cooperative after the third day, and
- others are seen as more aggressive after the second day.

The greater apparent aggressiveness among group members after 2-3 days may be symptomatic of increasing stress during prolonged teleconferencing, and if so it is a behavioural effect that needs to be guarded against. However it is possible to take a more positive interpretation of these findings.

These groups comprised members who had not previously met and thus not yet developed a 'group identity'. Social psychological studies of small groups have found that the creation of a group identity has to pass through three specific stages. The first is typified by a concern to establish a friendly atmosphere and not to offend other members of the group. This passes into a less differential stage of increasing aggressiveness which is necessary to establish group norms on the level of aggression to be tolerated. It is only this third stage of creating operational rules that enables the group to attend fully to tasks without

Figure 10.5 % Of Participants Reporting That Others Were Less Cooperative Than in Normal Face-to-face Meetings

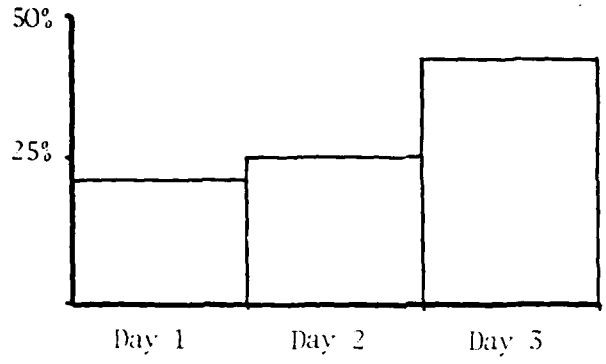


Figure 10.6 % Of Participants Reporting That Others Were More Aggressive Than in Normal Face-to-face Meetings

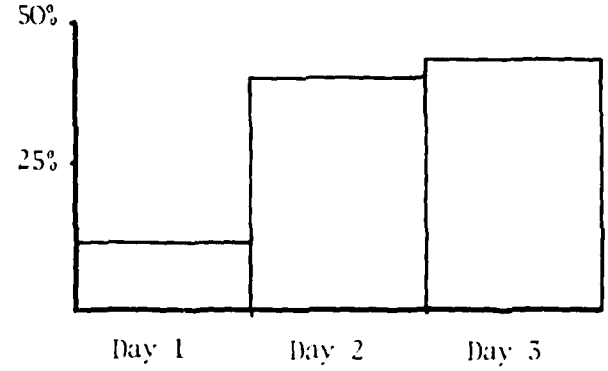


Figure 10.7 % of Participants Reporting that Others were More Friendly than in Normal Face-to-face Meetings

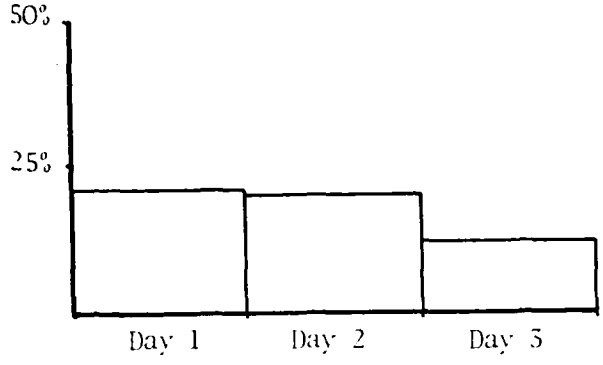
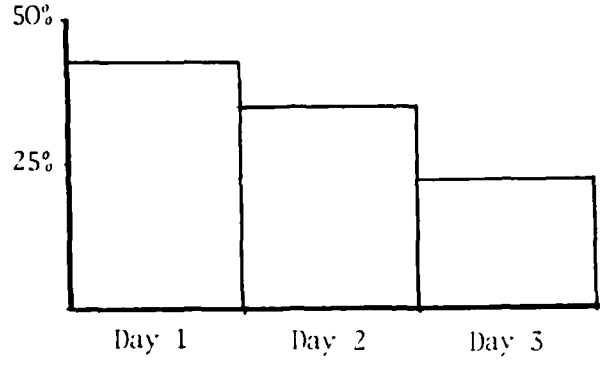


Figure 10.8 % of Participants Reporting that the Visual Image was Peculiar



diverting some energy on internal processes.

Weston, Kristen and O'Connor (1975) performed one of the few studies to have looked at this process taking place over multipoint video teleconferences. They compared group performance and development among students meeting face-to-face, over audio-only, and over full audio and video conference systems. They found that group development was slowed down over the video system, aggressiveness only appearing toward the end of the series of meetings, whilst the audio-only group never progressed beyond the first, tentative, stage.

If a corresponding interpretation is placed on the findings reported here, then we can deduce that substantial progress toward a cohesive, effective group has been made by the second day. However confirmation of the nature and reasons for the increase in aggression awaits further investigation. Preliminary understanding may be achieved through detailed analysis of tape recordings of the individual sessions.

10.7 Implications

The study of longer term teleconferencing has thrown into relief the need for two particular technical elaborations:

- Some simple method for the group to contact participants who have switched off their public reception was acknowledged previously (chapter 9), and the more extensive sub-group working that occurs in longer conferences has highlighted this necessity.
- In longer, more freely-structured teleconferences, the diversity of spontaneous contributions has demonstrated an acute need for some means of rapid room-to-room graphics/text transmission. Ideally, such transmission would be a live video picture, even if of very slow scan, in order to permit explanatory manipulation of the material.

Fatigue has been shown not to be a problem within teleconferences of duration up to about a working week, but some underlying build-up does seem to occur and become apparent after the conclusion of such sessions.

The dominance hierarchies that evolve during these meetings are seen to change according to task. This may be a further indication of

heightened attention to task, but the rationale is unclear.

Group members who first met over the teleconference system, were found to report greater aggressiveness in each other after 2-3 days of discussions. Given the existing knowledge of behavioural development in small groups, it is possible to draw a favourable interpretation of this effect; but in the teleconference environment of this project, the issue remains open.

Results for the group that met for the first morning under audio-only conditions, whilst tentative in view of the single sample, are nevertheless interesting:

- A highly impersonal mode of interaction was adopted, neglecting introductions, and resulting in a task-only orientation of the meeting.
- The meeting was reported as being particularly stressful and anxiety provoking.
- There was a reduced level of concordance among reported opinions on the relative dominance and contribution of participants.

It would thus seem that whilst video teleconferencing can be protracted without apparent deterioration, there is some cause for concern about the adequacy of audio-only teleconferences, especially when the participants have not previously become acquainted under more normal circumstances.

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ANNEX A 1 SOME GUIDELINES FOR THE DESIGN OF TELECONFERENCE SYSTEMS

ANNEX A 1 SOME GUIDELINES FOR THE DESIGN OF TELECONFERENCE SYSTEMS

1. INTRODUCTION

The purpose of this annex is to provide some general technical guidelines for the design of teleconference systems. A meeting conducted over a teleconference system replaces one which would have otherwise been held 'face to face'. It used to be thought that a teleconference system should simulate a 'face to face' meeting as realistically as possible. As a design strategy, this may now be open to question, but it is still reasonable to suppose that the teleconference equipment should not be unduly obtrusive or distracting. A teleconference meeting, like an ordinary 'face to face' meeting, can be expected to take considerably more time than a typical telephone call; it is important that the user should feel comfortable during the meeting, and that the teleconference system should provide an entirely natural medium for communication. However, there are technical limitations which put constraints on teleconference design, and these may prevent the designer from making his system appear as natural or 'transparent' to the user as he would wish. The choice of microphones, discussed in section 3 of this annex, is a good illustration of this point. Small lavalier microphones, which hang from the user's neck, may seem ideal, as the users tend to be unaware of the presence of their own microphones as well as those of other participants in the meeting. By contrast the conventional 'swan neck' design, which needs to be fixed to a table in front of the user, may take too much of the user's attention, and may be noticeable to other participants in the teleconference. However the 'swan neck' microphone has the capacity to reduce the likelihood of regenerative acoustic feedback by using its directional response to gain more sound from the user and less from the loudspeaker and, in addition, its fixed position tends to keep the conference participants 'on camera'.

The design of a teleconference system may be divided into its video and audio parts although, as the above example illustrates partly, the audio design affects the video system and vice versa. The salient aspects of the video part of any teleconference design are as follows:

- the participant must be kept 'on camera' to provide a facial image of a satisfactory size in the remote monitors.
- the video monitors (or screens in a projection system) should be placed at a comfortable viewing distance from the participant.

- the participants should be aware of the direction of the speaker's remarks (i.e. if A is talking to B, then C should be aware of this fact from the video alone).
- the participant should be able to see the video image clearly but must also be provided with sufficient illumination to perform other work during the meeting (e.g. examining documents).

The first point on this list is very important, since there is little point in a video conference system if the participants cannot be observed on the monitors. It is also important that the viewing distance is correct; the participant should neither be irritated by the strain of viewing a video image placed too far away, nor should he be aware of the line structure and other imperfections of a video image placed too close. A participant at a teleconference should be able to see any participant at any time, but he could easily be alarmed by the sensation that all statements made by other participants were directed at him. For this reason alone, it is quite useful to maintain to some extent the spatial correspondence of a normal 'face to face' meeting. In addition, if participant A is directing his speech to participant B, it is desirable that participant C should be able to deduce this entirely from visual cues. If the participants are to operate effectively during a long teleconference, they must be able to see all the video images clearly but the ambient illumination in each room should be sufficient to allow their own cameras to work properly and to allow the participants to read documents.

The audio system often presents more difficult problems to the designer than those which he encounters on the video side. A good audio system should have the following features:

- there should be no 'howl-around' or distortion of the sound
- the sound should be of sufficient volume for the participants to hear comfortably
- any extraneous noise should be as low as possible
- the microphones should be unobtrusive
- there should be little variation in sound level as the speaker moves his head in the normal course of a conversation
- at each location of the teleconference system the participating speakers should be heard at similar levels of loudness.

The most serious problem normally encountered by audio systems is regenerative feedback from loudspeaker to microphone, which causes an instability known as 'howl-around'. Even if the feedback is insufficient to cause instability, it may still cause some distortion or 'coloration' of the sound. Naturally the likelihood of regenerative feedback is increased as the gain of the audio system is increased so that, as the sound level in a conference room is raised, the problem of 'howl-around' becmes more difficult. There are various electronic techniques for countering the problem of 'howl-around', and these are discussed in section 3, but it is suggested in that section that the best way of dealing with this problem is to concentrate on the acoustic design of the rooms. Indeed, proper attention to the latter can reduce the level of extraneous noise as well as improve the quality of the sound. The problems of making the microphones unobtrusive and of ensuring that the speaker's head movements do not give rise to wide variations in sound level are both alleviated by increasing the distance between the speaker and his microphone. However, if this distance is increased too much, 'howl-around' can occur.

2. THE VIDEO SYSTEM

2.1 Screen Size

The question of screen size is linked to viewing distance, which is considered in the following subsection. It is assumed here that screen size is proportional to viewing distance, so that the screens of different sizes subtend the same angle at the eye. Early research on visual acuity has demonstrated that visual acuity increases with viewing distance for distances up to 60" and then remains constant. This suggests that viewers should be more tolerant of a small image viewed from a small distance than of a large image viewed from a great distance. However, it is also known that images on a small screen tend to look smaller than the original objects which they depict, whilst images projected onto large screens are seen as possessing the original sizes of the objects. Furthermore, the effect of binocular cues, which provide the viewer with depth perception, decreases as the viewing distance increases. Thus images on a small screen viewed from a short distance tend to appear as flat as the screen itself, but the perception of depth of the objects depicted is improved if the same images are projected onto a larger screen and are viewed from a greater distance. Furthermore, it is known that, in human vision, the 'near point' tends to recede with age; i.e.

old people cannot focus on near objects as well as young people.

Research into visual acuity suggests a small screen close to the viewer as the best solution, but work on the perception of depth and the impression of reality suggests that a large screen far from the viewer would be the most appropriate. Certainly, images on a 3" video monitor would be unlikely to convey a sense of reality, but the vast space required for a large projection system probably rules out this solution. In addition the current technology for projection TV systems poses some problems, if one screen is viewed by more than one participant, as the overall luminance, hue and saturation (if colour is used) vary with the position of the viewer. Therefore it is suggested that video monitors of normal sizes (10"-20") should be adequate for most teleconference systems.

2.2 Viewing Distance

It has been demonstrated that, for any particular bandwidth and size of television image, different subjects choose similar viewing distances, and that the ratio of preferred viewing distance (V) to picture height (H) is a consistent and repeatable measure dependent on the bandwidth of the image viewed. The bandwidth of a television image depends upon the horizontal resolution, offered by a single line scan, and the vertical resolution, as given by the number of lines in a frame. Television viewers sit close enough to the screen to be able to see details of the image, but not so close as to make the television's line structure noticeable. For a 625-line television image with a bandwidth of 5 MHz the viewing ratio is approximately 6. The viewing ratio for an American 525-line image is slightly larger.

If information is presented in text or in graphical form, the screen will need to be closer to the viewer. A teleconference system, in which text or graphics is transmitted via video, will probably need a separate screen for this purpose at each location.

2.3 Aspect Ratio and Relative Size of Facial Image

The facial image should fill as much of the screen as possible but, as the image size is increased, the problem of keeping the conference participant 'on camera' becomes more difficult. If the participant's head could be held stationary, the ideal aspect ratio of the screen would be about 3 : 4 (i.e. the height is greater than the width). However, as

participants will tend to move their heads about in front of the camera and, as horizontal movement will be much greater than vertical movement, the width of the screen should be a little greater than its height. The aspect ratio of the Bell Picturephone Mod. II was 11 : 10 but the wider screens used in broadcast television are quite suitable for a teleconference system. It should be noted that the proposed new 1125-line broadcast television standard uses a wide screen with an aspect ratio of 8 : 3.

2.4 Direction of Scan

Broadcast television systems use horizontal scanning and this is quite satisfactory for the reproduction of facial images which are required in a teleconference system. However, if it is intended to display text on the monitors, then vertical scanning may be more suitable. It was for this reason that the British Post Office's experimental viewphone service made use of vertical scanning.

The perception of flicker varies with the direction of scan. According to one theory, flicker is most noticeable (and therefore most objectionable) when the television screen is scanned at 45° to the horizontal. However, it is generally accepted that vertical scanning is far more susceptible to problems of flicker than horizontal scanning, and it is doubtful whether the advantage of vertical scanning in the perception of text outweighs the disadvantage of increased flicker.

2.5 Room Illumination

The room illumination should be sufficient to allow the cameras to operate but not so great as to make it difficult for the participants to view the monitors. In addition, the lighting should be such as to enable the conference participants to read documents comfortably. Fortunately, modern cameras can operate without special lighting, which, in any case, would be distracting and tiring for the conference participants. However, as the level of illumination is reduced the camera's aperture must be increased (i.e. the f-number reduced) and this results in a smaller depth of focus. The problem of viewing video monitors in a brightly lit room may be alleviated by setting the latter against a dark background.

A good lighting design will maintain a balance between background illumination and 'modelling light'. The 'modelling light' should come from one source, which should not shine directly at the camera's subject, but should illuminate the subject in such a way as to enhance the

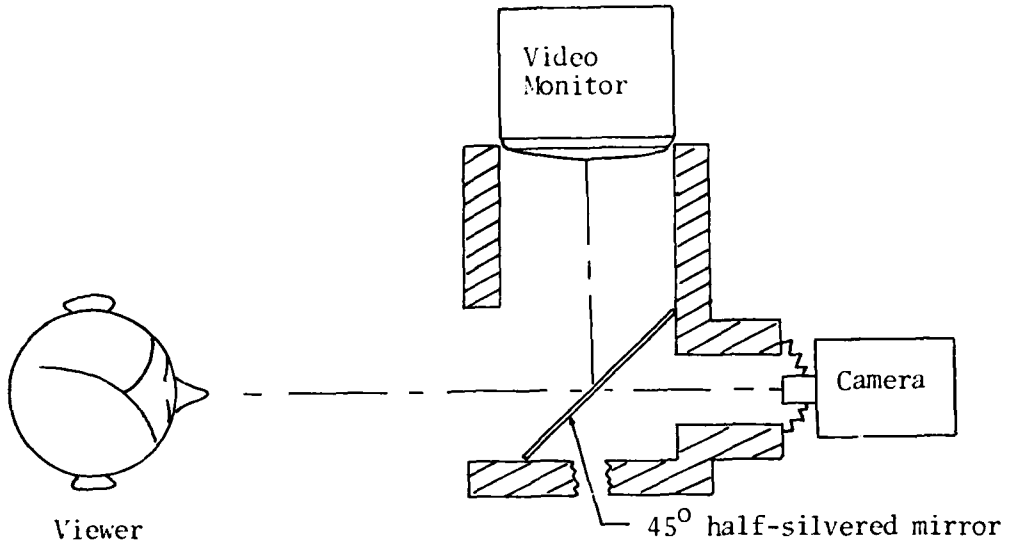


Fig. 1 Viewing arrangement with a half-silvered mirror

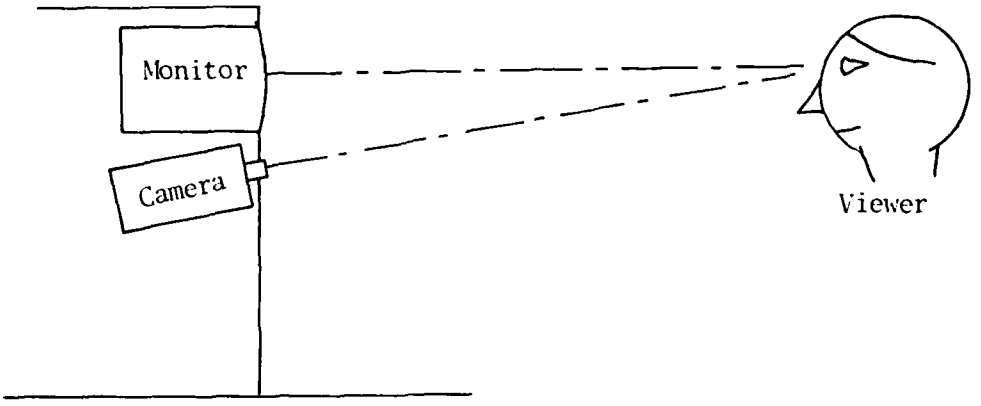


Fig. 2 Viewing arrangement with camera underneath the monitor

features of the face.

2.6 Camera Position

The distance between a participant and his camera is not normally a problem in teleconference systems. If the camera is too close, then head movements will cause large changes in the size of the resultant facial image, which may also suffer from perceptual distortion. Generally, a camera placed close to the video monitors, which the teleconference participant views, gives adequate results.

If individual cameras are provided with each monitor (see 2.8), then it may be possible to place the camera so that, when two participants are engaged in conversation, eye-contact is established. The arrangement shown in Figure 1 makes use of a half-silvered mirror to force the participant to look directly into the camera, when he looks into the eyes of the other participant. However, it has been shown that more eye contact is established if the teleconference participants direct their gaze slightly above the axis of the camera lens. Therefore the simpler arrangement of Figure 2, where the camera is placed below the monitor, should prove satisfactory.

If there is only one camera for a set of monitors, then the camera should be located in the centre of the array of monitors.

2.7 The Use of Colour

Considerable research effort has been expended on the question of whether colour aids the transmission of information from a video image to a viewer. Many of the results are contradictory, but it is generally held that, in this respect, colour offers no advantage over a monochrome image. However, a colour image is a better representation of reality and, as colour is in widespread use in broadcast television, it is reasonable to suppose that colour will be more acceptable than monochrome in a teleconference system.

2.8 The Arrangement of Monitors

A teleconference system may have its monitors and cameras arranged in one of the following ways:

- a longitudinal array of monitors with a single camera located centrally (Figure 3).

- a 2-dimensional array of monitors with a single camera located centrally (Figure 4).
- a single monitor with a divided picture and with a single camera located underneath the monitor (Figure 5).
- a multi-camera system with the monitors placed around a meeting table (Figure 6).

Figures 3-6 illustrate these designs for the particular case, where the teleconference consists of four participants in four separate locations, and the following discussion centres on this example.

The main advantage of the 3-camera system shown in Figure 6 is that the full spatial correspondence of a 'face to face' meeting is maintained by the teleconference simulation. If participant A talks to participant B, then A looks directly into B's monitor and vice versa. Participant C, acting as an observer, is made aware of the conversation simply by looking at the monitors corresponding to A and B. The main problem with the 3-camera system is the difficulty in keeping the participants simultaneously 'on camera' from each of the three viewpoints. In addition, this approach may result in a more obtrusive system than the others, although this does depend upon the design of the teleconference furniture. Finally, depending upon the method used for switching the video signals between the various locations, the 3-camera system may be burdened by higher transmission costs than the other three designs.

The systems shown in figures 3-5 cannot have the full spatial correspondence of the 3-camera system but the systems are improved considerably in this respect if the direction of horizontal scan in the cameras is reversed. For example, if A is talking to B (Figure 4), then A will look to his right and B will look to his left. If the direction of horizontal scan is reversed for all the cameras, then C will see A looking to his left and B looking to his right. Therefore C will see A and B looking in each other's directions.

In comparing the longitudinal array (Figure 3) with the 2 x 2 array (Figure 4), it may be noted that the vertical head movement required of the participants in the 2 x 2 array makes it easier for observers to conversations to decide who is talking to whom. For example, if A is

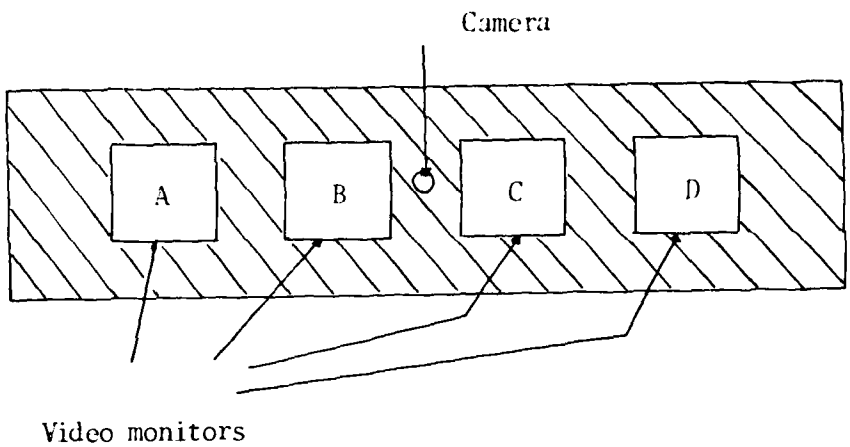


Fig. 3 Longitudinal array

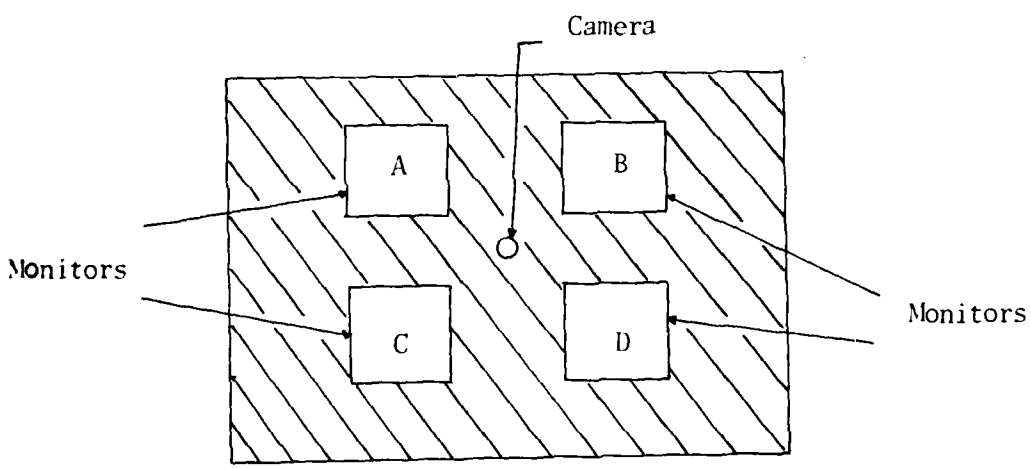


Fig. 4 2 x 2 array

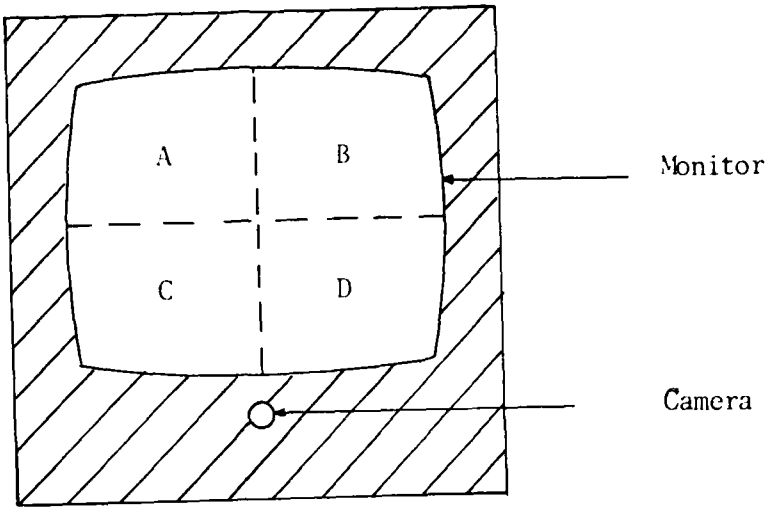


Fig. 5 Divided picture

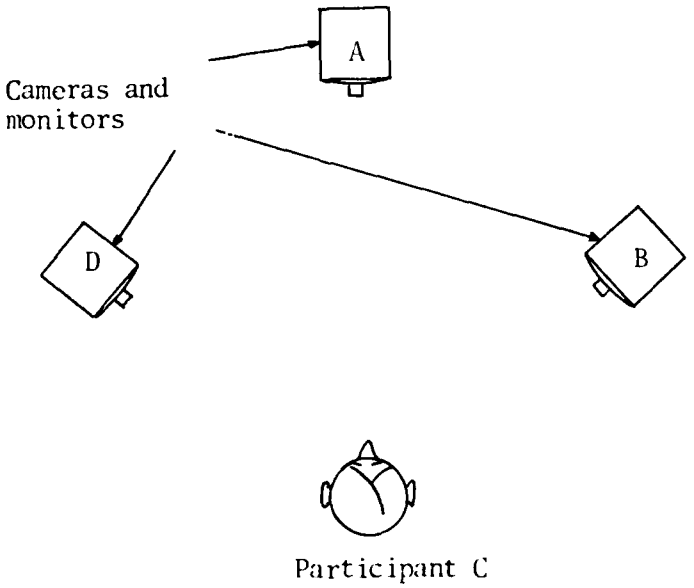


Fig. 6 3-camera system

directing his comments to D, then B sees A looking to his left in the longitudinal array and may be uncertain as to whether A is talking to B, C or D. However, in the 2 x 2 array B will see A looking to his left and downwards and can therefore assume that A is talking to D. Another advantage of the 2-dimensional array is that it can accommodate an increase in the number of monitors rather more easily than the longitudinal array.

The system shown in Figure 5 uses a divided video image to display all four participants simultaneously. This approach has the advantage of requiring only one monitor but, although it is a simple matter to combine video images electronically, they must be synchronized before they can be mixed. This may be achieved by transmitting TV sync pulses to each conference room or else frame synchronizers, which are complex and expensive devices, must be used at each location.

3. THE AUDIO SYSTEM

3.1 Loudspeaking Telephones

It is normal to use loudspeaking telephones (i.e. a separate microphone and loudspeaker) in teleconference systems although, in principle, ordinary telephone handsets could be used. However, telephone handsets would obscure the faces of the conference participants and would therefore partly destroy the purpose of the video-conference facility. In addition, telephone handsets would be inconvenient during a long meeting, when participants might require their hands free for other activities. The advantages of using telephone handsets are the absence of acoustic feedback and the greater tolerance to local room noise.

The main problem with systems using separate microphones and loudspeakers is associated with the control of acoustic feedback. Sound from a loudspeaker in one location may be picked up by a microphone and reproduced at its origin by another loudspeaker. If the overall gain of the system is too high, this feedback mechanism can become regenerative. In this case an audible oscillation or 'howl-around' occurs which renders the system unusable. There are various methods for controlling acoustic feedback and these are the subject of the remainder of this section.

3.2 Acoustic Feedback in an Open System

A teleconference design with an 'open' acoustic system is one in

which all microphones transmit sound signals, which are amplified and converted into sound energy at all remote locations of the teleconference. Such a system provides the most natural simulation of a 'face to face' meeting since, even though a well conducted meeting should have only one participant speaking at a time, there are usually sounds made by other participants, who indicate their response to the speaker with an occasional 'Oh', 'Ah' or 'Umm'. By contrast a 'voice-switching' system of the type described in 3.4.1 allows only one audio channel to operate at a time and will therefore cut out many of these extraneous sounds. The open system thus provides a good simulation of a 'face to face' meeting, but it suffers from a susceptibility to 'howl-around' as well as from noise. Unwanted sounds present in each teleconference location are reproduced through loudspeakers at each of the other locations. In this way the noise level in each conference room can build up to an undesirable extent. However, the problems of noise and of acoustic feedback may both be controlled by attention to the acoustic design of the conference room.

Acoustic feedback occurs because a microphone picks up sound not only from the conference participant but also from any of the loudspeakers present in the room. The problem may be controlled by ensuring that, as far as possible, the microphone only accepts sound from the participant and not from other sources. Directional microphones alleviate the problem of acoustic feedback but they cannot solve it alone. Much of the sound picked up by a microphone comes directly from the source, but there will always be sound that arrives at the microphone after undergoing multiple reflections at the walls, floor or ceiling. A directional microphone may reduce the sound it picks up directly from a loudspeaker, but it can do nothing about that fraction of sound which arrives at the microphone from the same direction as the participant.

The difficulty with sound reflections at the surfaces of the conference room is not only that they provide several paths from the loudspeakers to the microphone but also that, if sound energy is not absorbed sufficiently at each reflection, the sound remains in the room for some time after its production. A room like this with a long reverberation time degrades the quality of speech produced in the room and makes the control of acoustic feedback very difficult. It is essential to reduce the reverberation time to an acceptable value by

increasing the acoustic damping in the room. This may be achieved by laying carpets on the floor, fixing acoustic tiles to the ceiling and, if necessary, hanging heavy drapes down the walls.

It should be remembered that, if the room is acoustically over-damped, so that it begins to approximate to an anechoic chamber, then speech generated in the room by the participant or by one of the loudspeakers will sound 'lifeless'. Therefore a balance must be obtained between the prevention of 'howl-around' and the maintenance of normal acoustic conditions in the room. The best way of achieving this balance is to concentrate the acoustic damping on the wall behind the participant.

If the room's dimensions are simple multiples of each other, then the room may become an acoustic resonant cavity. This is undesirable even in a well damped room, and the room should be altered by artificial walls or ceilings to prevent it from adding 'boom' to the sound produced in the room.

The other features of teleconference design which affect acoustic feedback are the positions of the loudspeakers and microphone relative to the participant and the electronic gain in the audio system. The audio-gain would normally be set so that each participant hears speech from the others at the same level as he would hear them, if they were in the same room. If there are difficulties with 'howl-around' at this level, then the gain should be reduced. The question of microphone and loudspeaker position is discussed in the next subsection.

Good acoustic design will reduce the noise level in the tele-conference system. However, it should be borne in mind that, if the room is acoustically 'dead' with no noise present from sources outside the room, the teleconference participants may become over critical of the sound quality in the system.

3.3 The Positions of the Microphone and Loudspeakers

It is natural for the sound in the system to emanate from the same position as the visual image, and therefore the loudspeaker should be located as close as possible to its associated video monitor. The microphone should be located at some point on a line between the

participant and the camera in a single camera system. If the microphone is too close to the participant, then it could become obtrusive, but more importantly there will be large changes in the sound level as the participant moves his head. If the microphone is too far from the participant, then the fraction of sound that it receives from the participant may be reduced to a level where acoustic feedback becomes a problem. For an 'open' system in a room with normal acoustics the distance between the participant's mouth and the microphone should be about 12".

When directional microphones are used to minimize the sound picked up from the loudspeakers, the microphones and loudspeakers should be fixed in position to achieve this effect.

3.4 Other Techniques to Counter Acoustic Feedback

3.4.1 Voice-switching. In voice-switching systems the problem of acoustic feedback is removed by allowing only one audio channel to be active at any particular time. When a participant begins to speak, his sound level is detected and his audio channel becomes active so that his speech is reproduced by the loudspeakers at the remote locations. Voice-switching systems are effective in removing 'howl-around', and this enables the microphone to be placed at a greater distance from the participant, but these systems suffer from the following disadvantages:

- the first syllable of speech in the new active channel may be clipped
- audio channels may be switched by extraneous sounds
- it may be difficult to 'break into' the system
- the process of switching the voice signals may be irritating to the listener.

The fourth disadvantage may be alleviated by switching a finite loss in and out of the voice channels instead of switching the channels 'ON' and 'OFF'. Indeed, if the switching transient between 'full loss' and 'no loss' is made quite smooth, then the listener will not experience the irritating side-effects of ON/OFF switching. However, as the switching speed is reduced, problems will be experienced with clipping of the first syllable of speech in the new active channel.

3.4.2 Frequency shifting. A 'frequency shifter' attempts to remove regenerative acoustic feedback by shifting the frequency spectrum of the speech by a few Hz. A signal inserted into the feedback loop at one point

can never be regenerated at the same point, so that linear system theory will not predict instability. In practice, as signal levels in the system increase beyond a certain level, the system ceases to become linear and instability does occur. However, it has been claimed that, with a frequency shifter in the audio system, instability occurs at gain levels of 6 dB higher than that which would prevail in an ordinary system, but experimental results have shown that the claimed 6 dB improvement may be 3 or 4 db higher than that which can be achieved in practice.

ANNEX A2 TECHNICAL STRUCTURE OF THE CONTROLLER'S SWITCHING APPARATUS

ANNEX A2

TECHNICAL STRUCTURE OF THE CONTROLLER'S SWITCHING APPARATUS

The scheme of the audio switching logic required was fairly complex and it was thus decided to make use of the very low power consumption of C-MOS technology. The primary audio switching unit was constructed on a racking system incorporating interchangeable circuit cards for each participant's room. These cards used wire-wrap techniques to interconnect the various C-MOS integrated circuit logic elements. All the miniature indicator lamps were driven directly by this circuitry, but some pre-amplification of the microphone outputs was performed by appropriate purpose-built printed circuit boards in order to achieve a level suited to the auxiliary input of the commercial power amplifiers. The audio power outputs were then indirectly controlled via miniature low-power relays.

Some problems were experienced in the early stages of implementation with the integrity of the audio switching functions. This was due to the vulnerability of C-MOS technology to the vagaries of handling and operation involved in developing prototype equipment. Since the intended video switching functions were very much simpler than the audio, these were designed around straightforward transistor driven dry reed relay circuits. Again, interchangeable circuit cards were used for each participants room, and these indeed proved to be more robust and reliable than the C-MOS chips, but the multiplication in scale and vastly greater power consumption would still inhibit their use for the necessary audio switching logic. By modification of the 'termination' impedance within each television monitor and careful resistive shunting of the video signal lines at the switching unit, problems of 'ghost' reflections and varying brightness resulting from the switched picture distribution were overcome.

The Controller's station was found to be ergonomically very favourable and no difficulty was experienced in carrying out all the operations necessary to satisfy the requirements of the participants as they arose, as well as running the monitoring equipment.

ANNEX A 3 DESCRIPTION OF THE EVENT MONITORING EQUIPMENT

EXECUTIVE SUMMARY

The ARPA event monitoring program together with the associated plug-in interface board allows the Apple II computer to monitor up to 128 electrical inputs. The program outputs a system log which itemizes the start-time and duration of each event and, at the end of a run, an events summary which gives the number of events which have occurred for each input together with the total duration of those events.

This report describes the method of loading and operating the program.

1. INTRODUCTION

The program is divided into two parts:

- A small machine code program that calculates the time using 1 second pulses from the interface board.
- A BASIC program that scans the inputs for level changes and produces the system log and the event summaries.

Before loading the program check that the ARPA interface board is plugged into one of the slots inside and at the back of the Apple II. If it is not then:

- SWITCH OFF THE APPLE
- plug the board into any slot and fasten the 'Delta' connector to the back panel
- connect the Apple and ARPA systems using the umbilical lead.

2. LOADING THE PROGRAM

1. Switch on the Apple.

2. Check that the cassette recorder is connected to the Apple and that the output level is set to 7.

3. Type LOAD, start the cassette playing and then press the return key. The Apple should 'bleep' once at the start of loading and again when it reaches the end of the BASIC program.

4. STOP THE CASSETTE.

5. Type: CALL - 151 (return)
   300. 352R

6. Start the cassette machine again and then press the return key. Monitor will 'bleep' once only when the program has been loaded.

7. Stop the cassette machine and rewind the tape.

8. Key CTRL - C (return) to get back to BASIC.

O.K. Now you're ready to run the program as described in the next section.

3. RUNNING THE PROGRAM

The program is mainly self documenting as can be seen from figures 1 to 4. However the following clarification may be helpful.

Firstly, to start the program type RUN (return). The program will display the information shown in Figure 1.

Remember that slot inside and at the back of the Apple? Well just behind the slot used by the ARPA interface board there will be a number. This is known as the slot number and is needed by the program to identify the interface card. Key it in to Apple as requested.

Next comes a request for the time (Figure 2). You give this as three separate figures for hours, minutes and seconds.

The program now wants to know how many inputs you intend it to scan, up to a maximum of 128 (Figure 3). If you are also dealing with the hardware side remember that the program scans by outputting addresses from Ø up to (the number of inputs - 1). This means that the inputs to be scanned must be placed in sequence within this address range - it is not possible to pick out addresses Ø, 1, 3, 5, 12Ø, for example.

For each input give a mnemonic of up to 6 characters. The program will use this mnemonic rather than the input number in listings. Give also the logical level you want the program to measure - in TTL levels Ø corresponds to 0 volts and 1 corresponds to 5 volts.

Finally, in the input section, give the shortest event you want listed. Because the clock only generates 1 second pulses the shortest event cannot be less than 2 seconds.

Figure 4 shows the last page output before listing starts. Tell the Apple if you want the log on the printer by keying YES or NO followed by return. You can then start the run by pressing the space bar.

Once the scan has started you can get a summary of the first 20 inputs by keying P on its own. For speed the summary will automatically appear on the monitor even if you are currently using the printer.

To end the run and get a full summary (only available when using the printer) key CTRL A. After the listing is complete the program executes a

STOP instruction which breaks out into BASIC command level. To re-enter the program without re-inputting the input parameters type CONT followed by return. This will automatically take you back to Figure 4.

4. THE LISTINGS

Figure 5 is a sample of the normal log output from the program and Figure 6 the events summary. The log output shows the start time of an event, not the finishing time, as well as the input name and the duration of the event.

The events summary totals these figures for each input giving the number of completed events and the aggregate number of minutes and seconds in the chosen state. If an event is currently in progress the number of completed events will have an asterisk alongside and the aggregate time will include the time clocked up in the current event.

```
****************************************
*   HELLO! WELCOME TO RICHARD'S EVENT  *
*MONITORING PROGRAM DESIGNED ESPECIALLY*
*                FOR ARPA.             *
****************************************


THE EDGE CONNECTORS IN THE BACK OF
APPLE ARE NUMBERED 0 TO 7 FROM LEFT
TO RIGHT.
PLEASE ENTER THE SLOT NUMBER FOR THE
MONITORING INTERFACE CARD (NORMALLY
5):5
```

FIG. 1 First page output by the program

```
WHAT TIME IS IT PLEASE?
HOURS:16
MINS:06
SECS:10
```

FIG. 2 The second page

```
HOW MANY INPUTS ARE TO BE MONITORED? 2

FOR EACH INPUT PLEASE GIVE A MNEMONIC
OF UP TO 6 CHARACTERS AND THE LEVEL
(0 OR 1) YOU WANT TIMED.

INPUT 0
MNEMONIC: A TO B
LEVEL TO BE TIMED: 1

INPUT 1
MNEMONIC: B TO C
LEVEL TO BE TIMED: 0

WHAT IS THE LENGTH IN SECS OF THE
SHORTEST EVENT YOU WANT MONITORED ( >1
SEC):2
```

FIG. 3 The input pages

```
TO INTERRUPT THE RUNNING OF THE PROGRAM
USE THE FOLLOWING CHARACTERS

CTRL A - TO END THE RUN

     P - TO OBTAIN A TOTALS SUMMARY OF
         THE FIRST 20 INPUTS WITHOUT
         STOPPING THE PROGRAM

DO YOU WANT THE LOG OUTPUT ON THE
PRINTER? Y

TO START THE RUN PRESS THE SPACE BAR

RUN STARTED AT 16:7:33
```

FIG. 4 The final pages before the start of the run

```
****************************************
*            THE SYSTEM LOG            *
****************************************

  START     INPUT      DURATION
  TIME      NAME       OF EVENT
16:7:33     A TO B    0 MINS 13 SECS
16:7:47     B TO C    0 MINS 3 SECS
16:7:51     A TO B    0 MINS 10 SECS
16:8:2      B TO C    0 MINS 10 SECS
16:8:12     A TO B    0 MINS 31 SECS
16:8:43     B TO C    1 MINS 5 SECS
16:9:48     A TO B    0 MINS 40 SECS
16:10:28    B TO C    1 MINS 14 SECS

****************************************
*          THE EVENTS SUMMARY          *
****************************************

 INPUT    TIMES USED        TOTAL USAGE
 A TO B        4          1 MINS 34 SECS
 B TO C        4          2 MINS 32 SECS
```

FIG. 5 A sample of typical output

THE HARDWARE

The hardware is divided into two sections; a racking system which interfaces to the ARPA equipment and selects the required input on receiving an address and an interface board which fits inside the Apple into one of the peripheral connectors and which addresses the racking system and arranges the data in a form acceptable to the microprocessor. The interface card also generates pulses every second as the Apple has no internal real time clock.

A circuit diagram of the interface card is given in Figure 6 together with a layout of the board in Figure 7 and a pin-out of the peripheral connecter in Figure 8 .

Reading of Data into Microprocessor

The relevant hardware and timing diagrams appropriate for the reading of data from the ARPA equipment are shown in Figure 9 . When the interface card is selected the $\overline{\text{I/O select}}$ line goes low forcing the RDY line low thus halting the microprocessor and consequently holding the address lines. The $\overline{\text{I/O select}}$ line is gated with the $\emptyset_0$ clock, internal to the Apple and so rises despite the state of the RDY line causing the flip-flop to toggle. Thus when the next $\overline{\text{I/O select}}$ pulse arrives the hardware interfaced to the ARPA system has had plenty of time to read the address and transmit the data. As the RDY line is now high the data is read into the microprocessor.

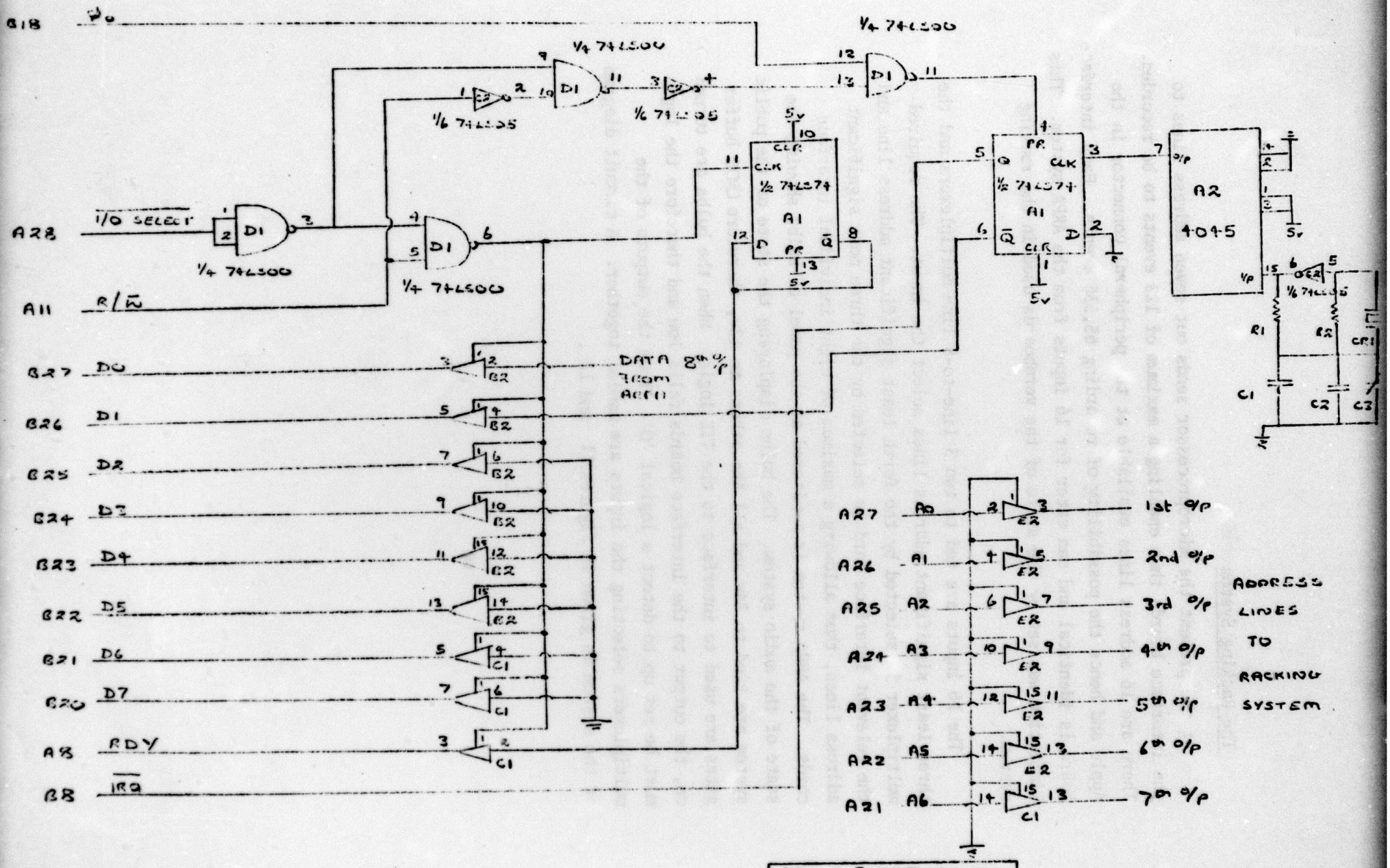
Generation of Interrupt Pulses

The machine code program which calculates the timing in the event counter is initiated by an interrupt pulse, $\overline{\text{IRQ}}$, which in turn is set by a 2.097152 MHz crystal operating in conjunction with a 21-stage counter to give an accurate seconds count. The timing diagrams are given in Figure 10 together with the relevant hardware. The clock generator sends a pulse every second to the flip-flop which clocks the $\overline{\text{IRQ}}$ pulse low thus starting the machine code program. One of the first instructions in this program is to look at the interface card, thus $\overline{\text{I/O select}}$ comes low presetting the flip-flop and consequently returning the interrupt pulse high. The $\overline{\text{Q}}$ output of the flip-flop is feed to the second data line so that a check can be made at the start of each timing routine that the interrupt pulse has in fact come from the clock generator.

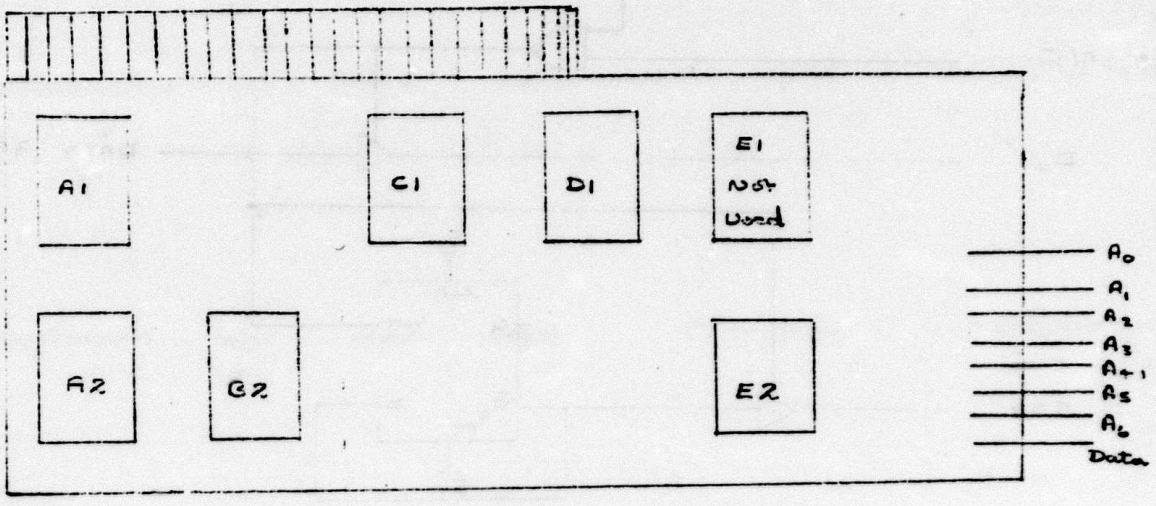
The Racking System

At the present the microprocessor sends out seven address lines to the interface boards thus enabling a maximum of 128 events to be recorded. There are 16 address lines available at the peripheral connector in the Apple and hence the possibility of recording 65,536 events. Each interface board is identical and can cater for 16 inputs from the ARPA system. This limitation was set by the style of the veroboards used in the racking system.

The 16 inputs are fed to two 3 line-to-8 line multiplexers and the three least significant address lines select the input. The required multiplexer is selected by the forth least significant address line and the relevant interface card is selected by the three most significant address lines, thus allowing a maximum of eight individual interface cards. The ARPA system is monitored at the panel of bulbs showing the state of the audio system. The bulbs displaying the state of the public system are tied to 24v and all the others to 12v, therefore CMOS buffer gates are used to interface to the TTL logic. When the bulbs are turned on, the output to the interface boards falls low and therefore the logic must be set up to detect a logical '0'. Thus the outputs of the multiplexers selecting the inputs are nanded together. A circuit diagram of the system is given in figures 11 and 12 .

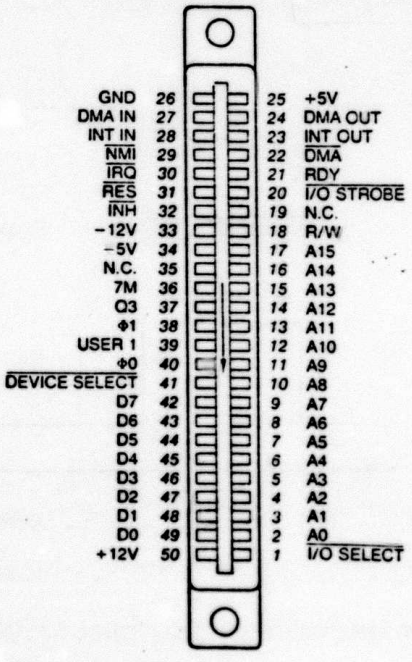


CIRCUIT DIAGRAM OF INTERFACE BOARD WHICH SITS INSIDE THE APPLE.



LAY-OUT Q3 INTERFACE BOARD

FIG 7

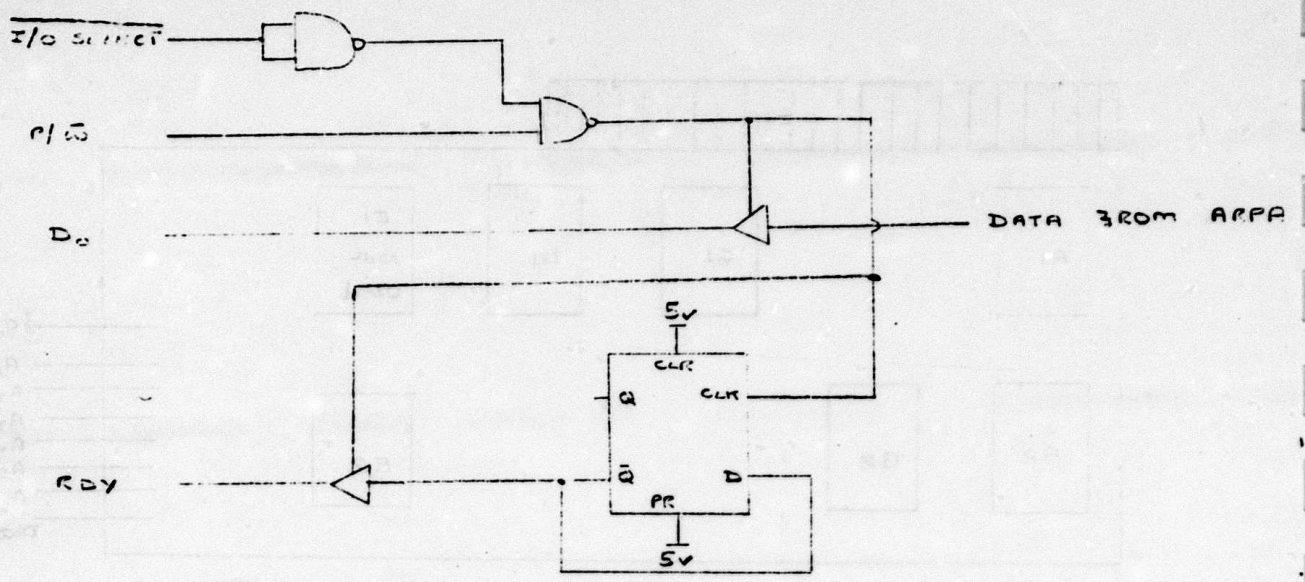


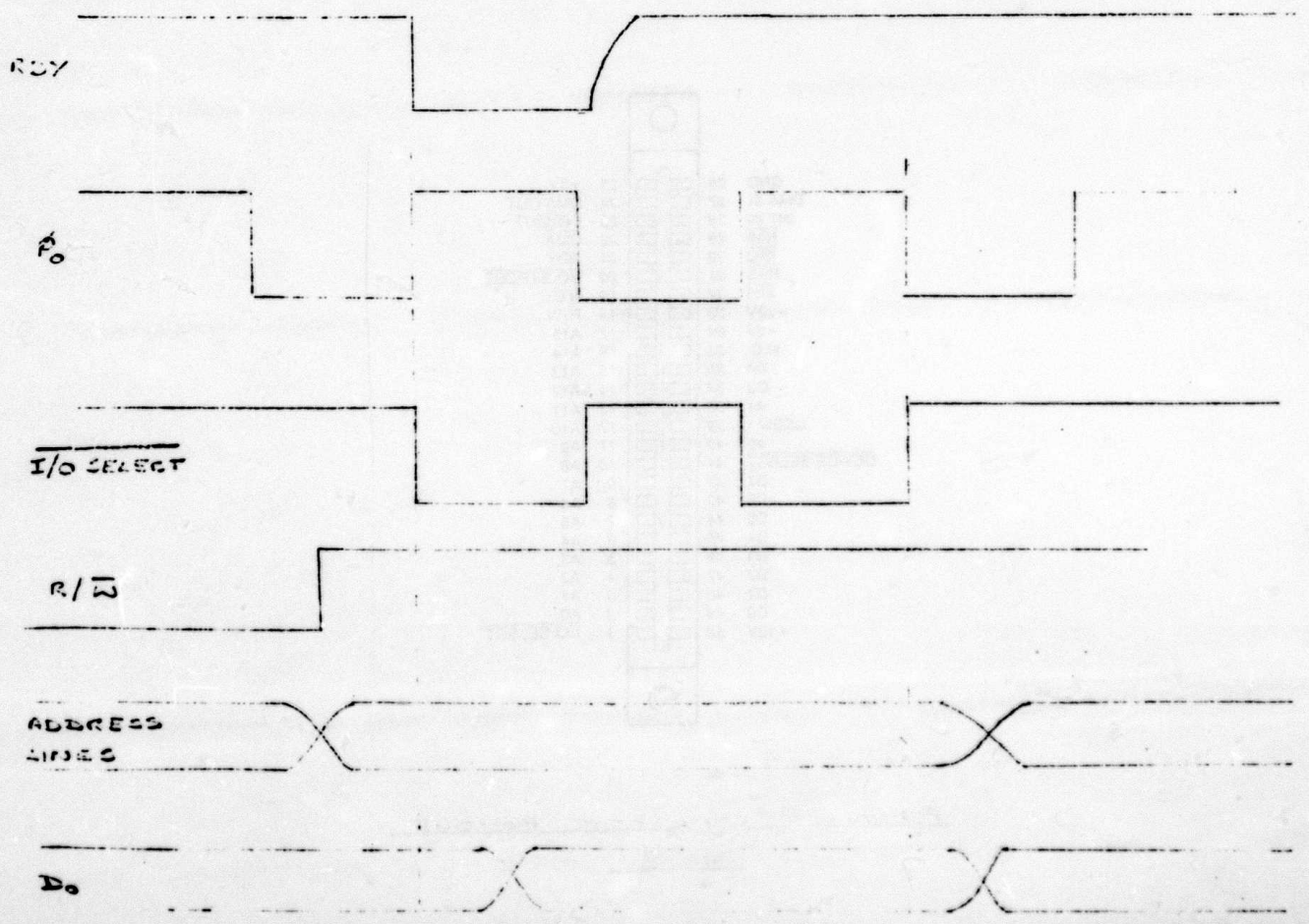
PERIPHERAL CONNECTOR PIN-OUT

FIG 8

TIMING AND HARDWARE DIAGRAMS FOR READING DATA FROM ARPA EQUIPMENT

FIG 9



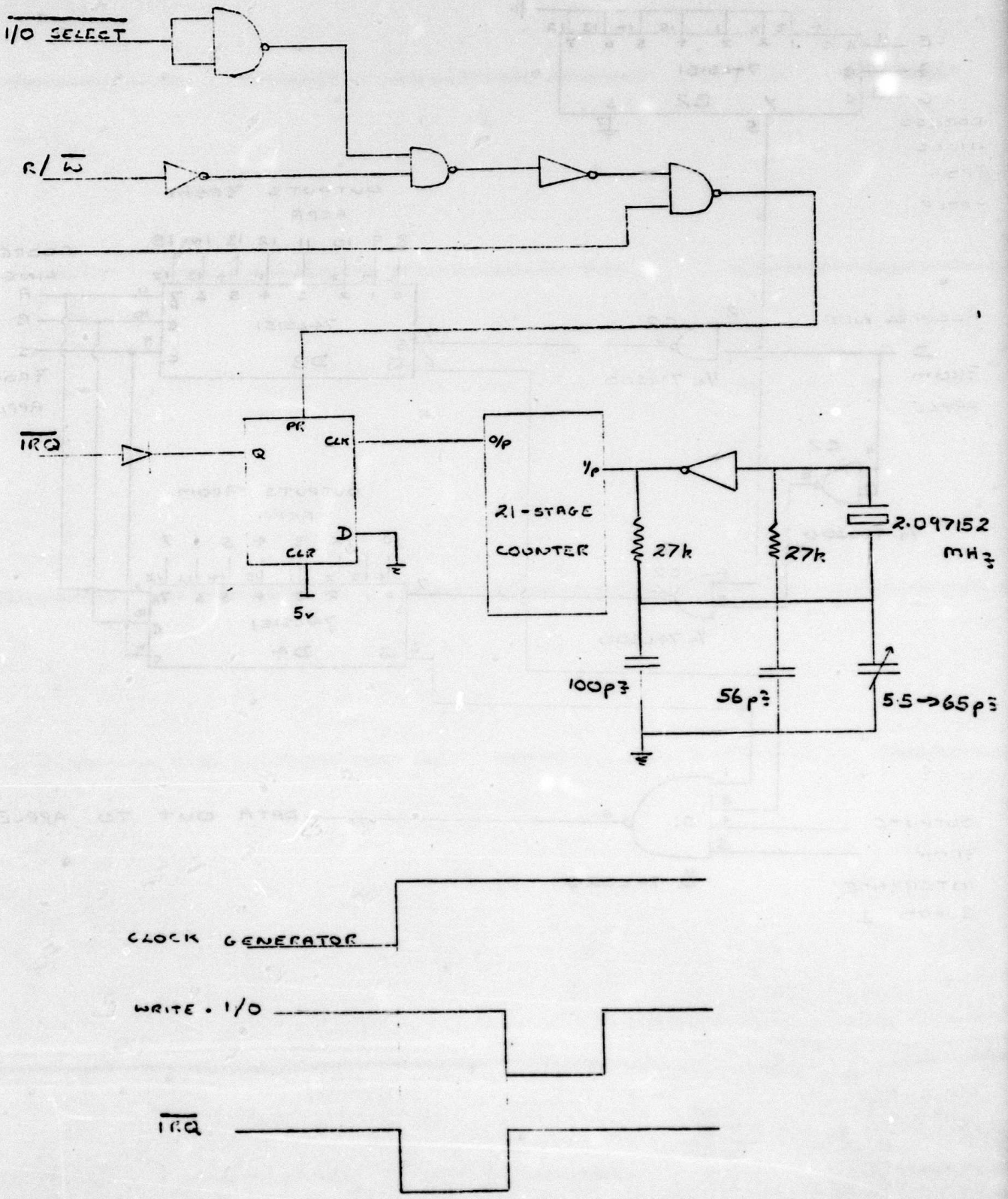


TIMING AND HARDWARE DIAGRAMS

TO SHOW GENERATION OF INTERRUPT

PULSES.

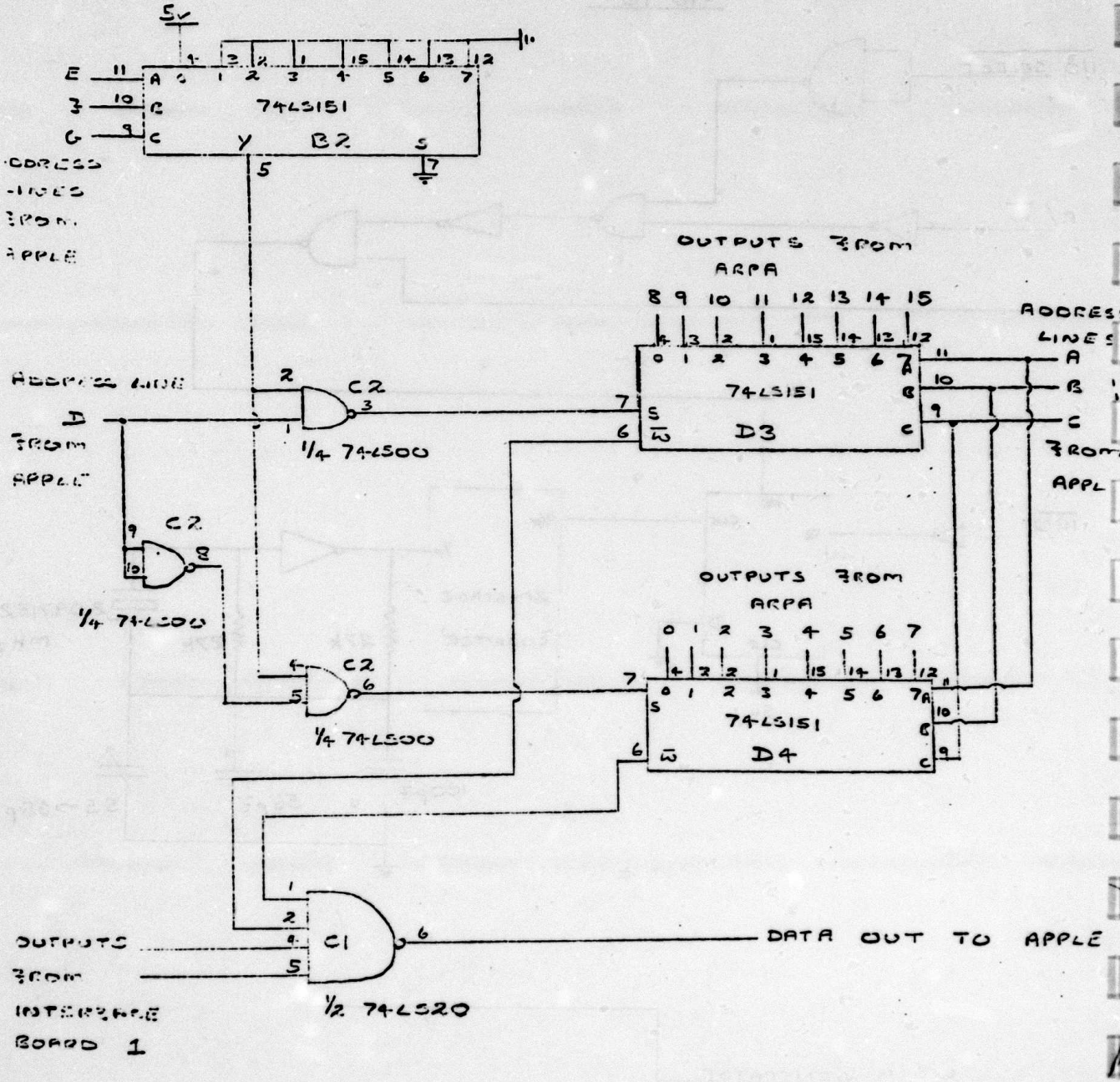
316 10



ARPA EVENT COUNTER

INTERFACE BOARD 0

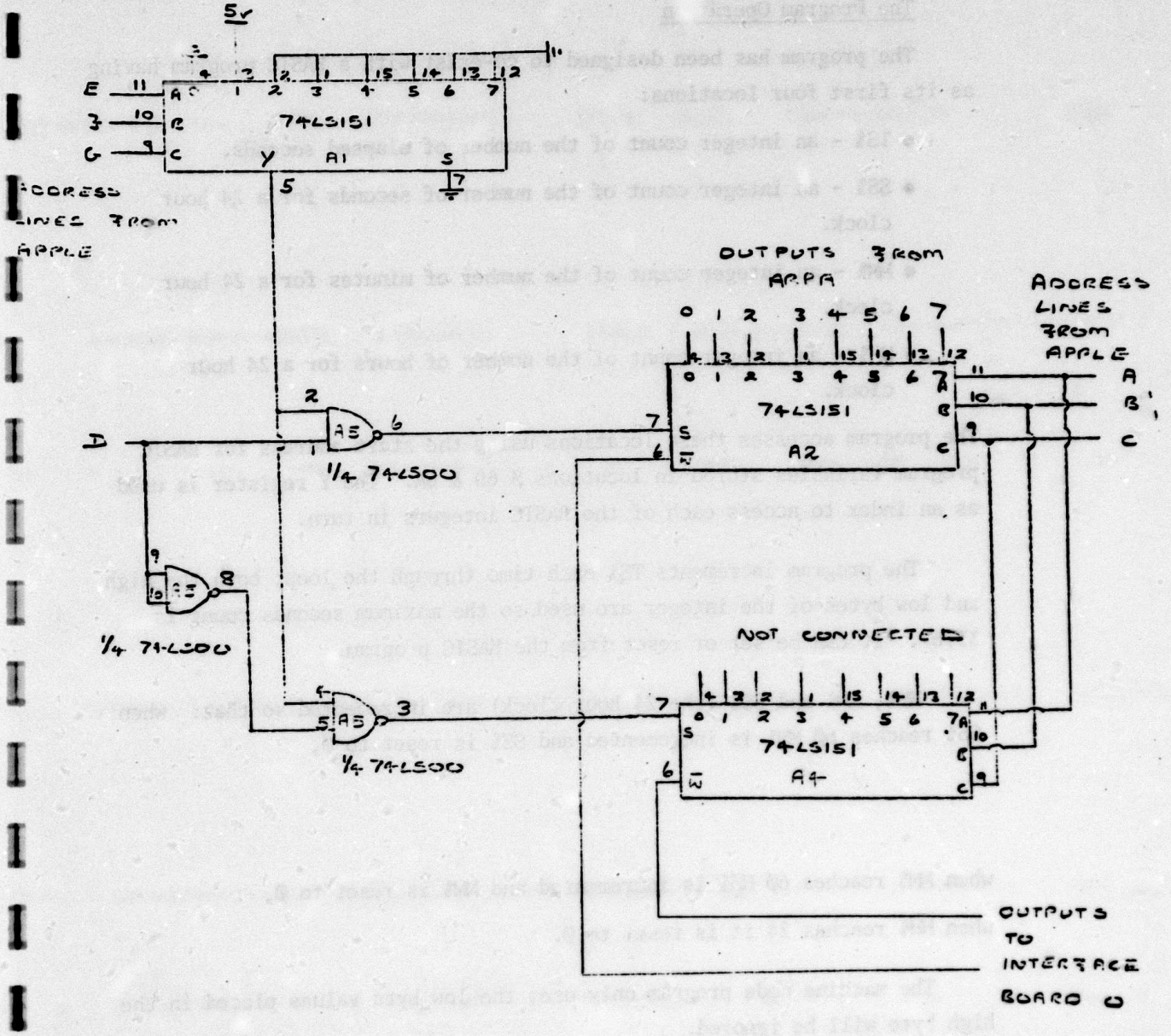
FIG 11



APPA EVENT COUNTER

INTERFACE BOARD 1

316 12



The Program Operation

The program has been designed to co-exist with a BASIC program having as its first four locations:

- TS% - an integer count of the number of elapsed seconds.
- SS% - an integer count of the number of seconds for a 24 hour clock.
- MM% - an integer count of the number of minutes for a 24 hour clock.
- HH% - an integer count of the number of hours for a 24 hour clock.

The program accesses these locations using the start address for BASIC program variables stored in locations $ 69 & 6A. The Y register is used as an index to access each of the BASIC integers in turn.

The program increments TS% each time through the loop; both the high and low bytes of the integer are used so the maximum seconds count is 32767. It can be set or reset from the BASIC program.

HH%, MM% and SS% (the 24 hour clock) are incremented so that: when SS% reaches 6Ø MM% is incremented and SS% is reset to Ø,

when MM% reaches 6Ø HH% is incremented and MM% is reset to Ø,

when HH% reaches 24 it is reset to Ø.

The machine code program only uses the low byte values placed in the high byte will be ignored.

Summary of Program Characteristics

The program is fully relocateable. It uses the A and Y registers having stored the original values in locations $ 45 and $ 47 respectively. The original values are restored at the end of the program.

The routine takes approximately 86 microseconds to execute.

ANNEX B 1 DISCUSSION TASKS

ANNEX B1 TASKS

The Financial Times Index game

This task was developed to provide an analytical problem which can be attempted by all types of intelligent subjects, who are aware of current affairs and some economic implications. Some evaluation of answers is possible. The purpose of this task is to decide upon an estimate for that day's Close of Day Financial Times Ordinary Share Index and for one week hence. This index is a widely used measure of the progress of 30 large companies from different sectors of the U.K. economy. The task assumes that movements of the Index are a measure of the confidence of those in the market. This confidence is partly attributable to those current news items such as reported strikes, profits or economic trends and more general or political items, such as the Olympics, acts of terrorism and the weather. The conferees thus have to estimate the relative importance of all items reported in the media and give a judgement as to their overall effect on the Index. They have to predict whether it will move up or down and to what degree.

The predictability of the Index was investigated by finding the correlation between the predicted movements and the actual movements made by the Index over one day and over a week. This relationship is shown in figures B.1 and B.2. The correlation for the day hence predictions is only significant[1] if a non-parametric test working on the order of values is applied. A general air of pessimism results in there being no correlation when a parametric test, such as Pearson's, is applied. The correlation between the week hence predictions and actual values of the Index, is significant[2] using Pearson's test.

However it is not possible to say to what degree people base their opinion on the physical properties of the recent movements of the Index as opposed to a rational deliberation of all their information sources.

---

1. Probability of the null hypothesis (that there is no correlation between the actual and predicted values of the Index) is true is < 0.05 on Spearman's Rank Correlation Test. One group's poor results are excluded from the calculations.
2. Probability of the null hypothesis (that there is no correlation between the actual and predicted movements of the Index) is true is < 0.01 on a two tailed Pearson's Product Moment Test.

FIGURE B.1 DAILY PREDICTIONS OF THE FT INDEX
(Base = 31)

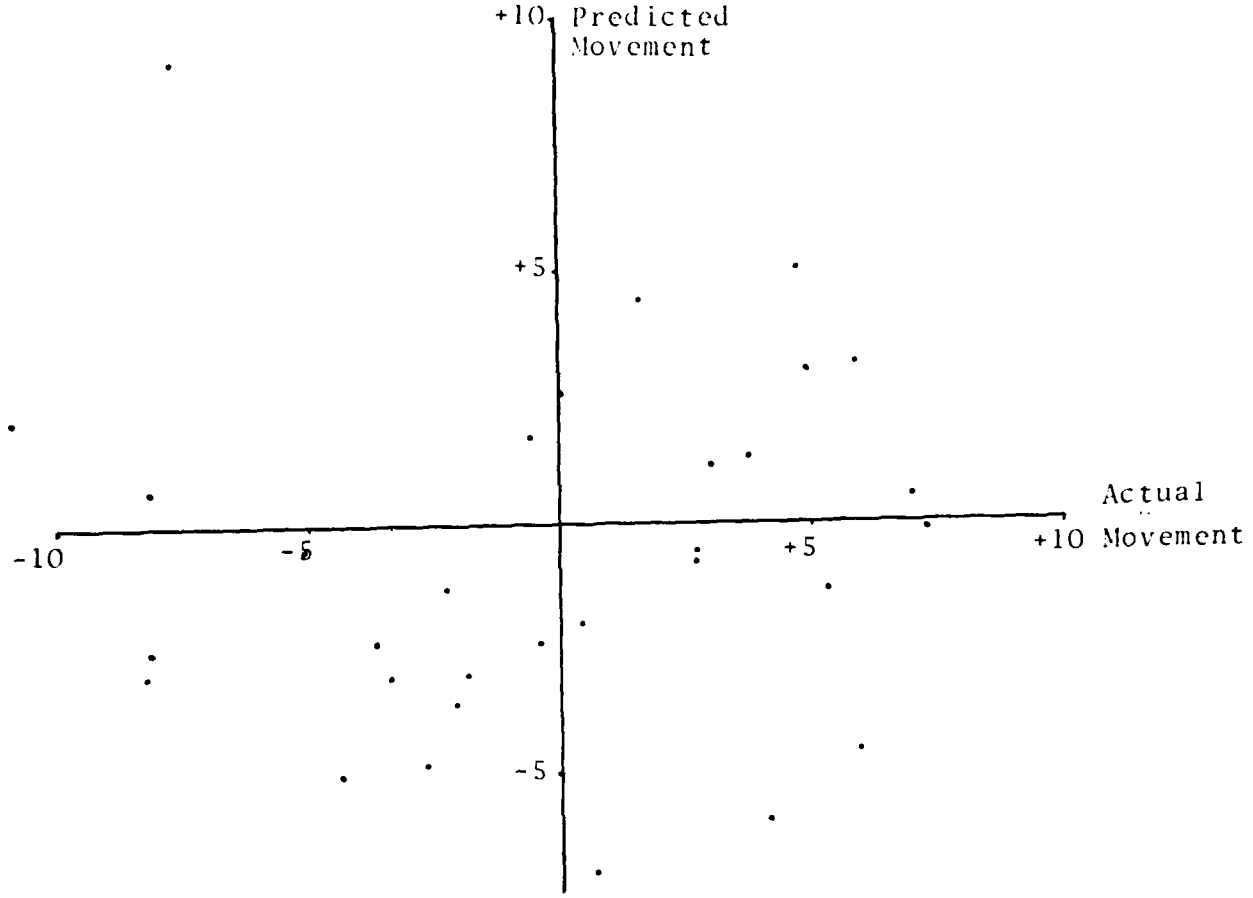
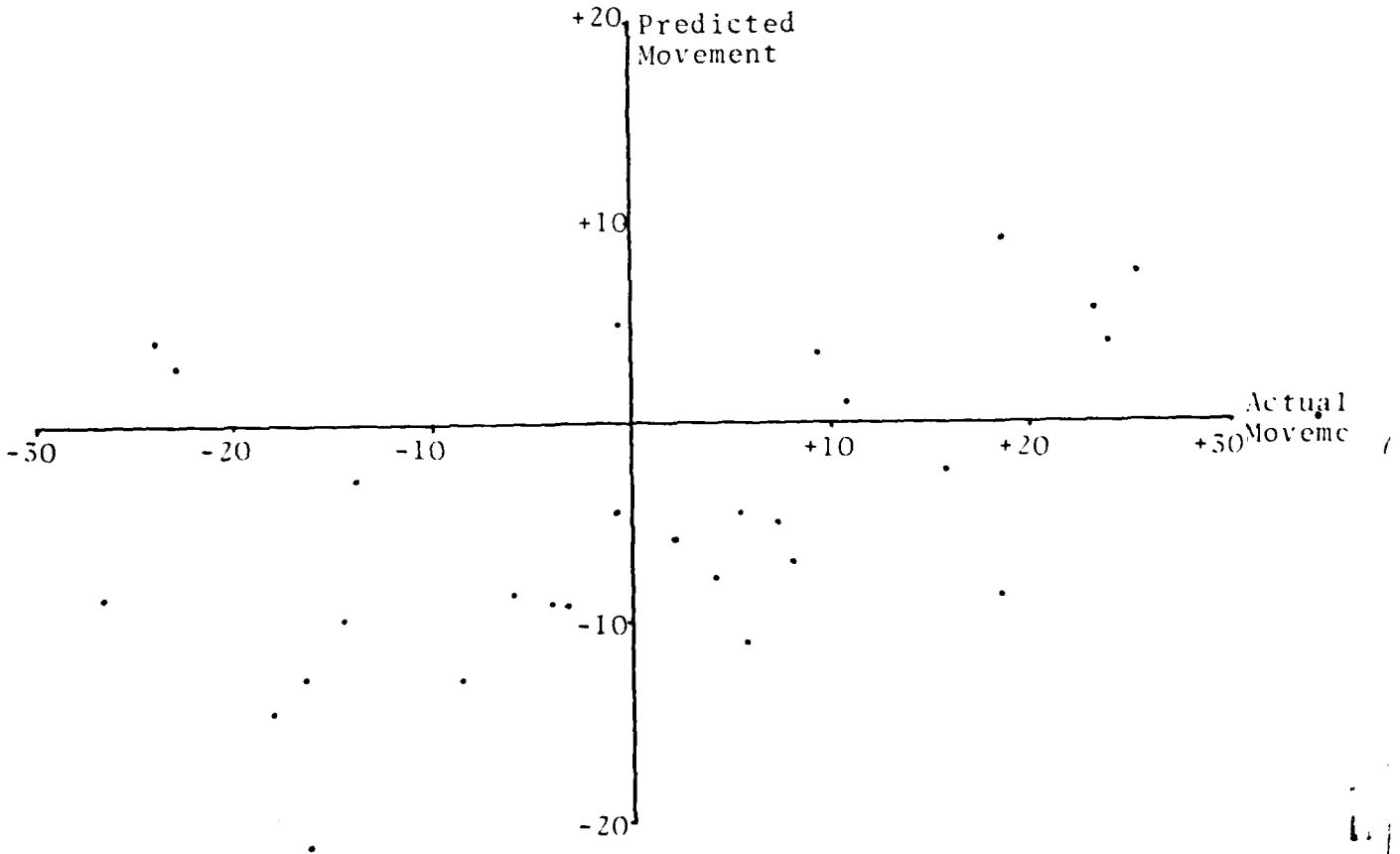


FIGURE B.2 WEEKLY PREDICTIONS OF THE FT INDEX
(Base = 31)



Procedure

The conferees are each given a set of instructions and a copy of today's Financial Times Index. Further information describing the recent behaviour of the Index may be made available either on their documents monitor or in the form of hard copy. They have forty minutes or one hour to give an opinion for that day's Close of Day index and for one week hence.

Evaluation

Ranking of answers is obtained directly from the magnitudes of the prediction errors.

THE FINANCIAL TIMES INDEX GAME

The purpose of this discussion is to decide upon an estimate for today's and next week's Financial Times close of day Ordinary Share Index.

A copy of today's Financial Times has been distributed, as has a graph of its recent behaviour.

The best estimate of the Indices will be calculated. The most successful or lucky group in each group of Sessions will share a prize.

You now have forty minutes. Please ask for help if you need it.

The Tour of London game

The benefits of this task are that all subjects are able to draw upon a wide knowledge of the relevant information needed to come to some decision. Again some evaluation of answers is possible. The purpose of this task is to plan a suitable tour for a group of business men visiting London. This tour should promote London (and indirectly the English company), as a suitably modern and yet established concern.

Procedure

The conferees are given a set of instructions, a tourist map of London and information about places of interest. There is also an answer sheet on which to draw out the chosen timetable. They have forty minutes or one hour to come to an agreed timetable.

Evaluation

The answers are scored with reference to itineries of commercial tour operators taking into consideration the particular brief for this tour. Points are awarded for each place, according to whether it also appears on the commercial itineries and whether it is actually entered or just viewed from the road. The whole tour must also be feasible within the allocated time span.

The Tour of London Game

A Japanese trade delegation with their families, a total of eight persons, will visit Luton next week. One day only has been set aside for a sight-seeing tour of London. You and your three colleagues are responsible for the selection of appropriate places of interest. The tour will commence from outside their Kensington hotel at 9.00 am on Friday and should finish by 7.00 pm.

You will be given forty minutes to decide upon a schedule which should incorporate as many places you consider important as is feasible during the time available. This tour should persuade them of the stability and desirability of you as a trading partner with evidence of both a great history and a firm commitment to the future.

Information about possible modes of transport and places of interest, their times of opening and whereabouts, has been distributed among you. The list is only intended to help, not constrain your decision.

An example of a schedule layout is provided.

Places of Interest in London for the Sightseer

(Times only shown where critical)

BANK OF ENGLAND
Threadneedle St., E.C.2

BUCKINGHAM PALACE
Changing of the Guard 11.30 a.m.
Queen's Gallery 11.00 a.m.-5.00 p.m.

HMS BELFAST (IMPERIAL WAR MUSEUM)
Symon's Wharf, Vine Lane, S.E.1.

CENOTAPH
Whitehall, S.W.1.

CENTRAL CRIMINAL COURT
Old Bailey, E.C.4.

CLARENCE HOUSE
Stableyard Rd., (The Mall), S.W.1.

CLEOPATRA'S NEEDLE
Victoria Embankment, W.C.2.

GRAY'S INN
High Holborn, W.C.1.

GUILDHALL
King St., E.C.2.

HOUSES OF PARLIAMENT
Parliament Sq., S.W.1.

LAMBETH PALACE
Lambeth Rd., S.E.1.
10 a.m.-12 noon

LAW COURTS (ROYAL COURTS OF JUSTICE)
Strand, W.C.2.

MANSION HOUSE
E.C.4.

MARBLE ARCH
Oxford St., W.1.

MARLBOROUGH HOUSE
Pall Mall, S.W.1.

MONUMENT
Monument St., E.C.3.
9 a.m.-4 p.m.

PETTICOAT LANE
Middlesex St., E.1.

PUBLIC RECORD OFFICE
Chancery Lane, W.C.2.

ST. BARTHOLOMEW'S HOSPITAL
Smithfield, E.C.1.

ST. JAMES' PALACE

ST. KATHERINE'S DOCK
St. Katherine's Way, E.1.

ST. PAUL'S CATHEDRAL
Ludgate Hill, E.C.4.

SCOTLAND YARD
Broadway, S.W.1.

SOMERSET HOUSE
Strand, W.C.2.

THE TEMPLE
Fleet St., E.C.4.

TOWER BRIDGE

THE TOWER OF LONDON
Ceremony of the Keys 9.40

TRAFALGAR SQUARE

WESTMINSTER ABBEY

WESTMINSTER CATHEDRAL
Ashley Place, S.W.1.

WESTMINSTER HALL
Parliament Sq., S.W.1.

LONDON PLANETARIUM
Marylebone Rd., N.W.1.
11 a.m.-4.30 p.m.

LONDON ZOO

MADAME TUSSAUD'S WAX EXHIBITION
Marylebone Rd., N.W.1.

Art Galleries

COMMONWEALTH INSTITUTE
Kensington High St., W.8.

Courtauld INSTITUTE GALLERIES
Woburn Sq., W.C.1.

BRITISH CRAFTS CENTRE
43 Earlham St., W.C.2.

DULWICH COLLEGE PICTURE GALLERY
Dulwich College, S.E.21.

FELIKS TOPOLSKI's STUDIO
Arch 158, Hungerford Bridge, S.E.1.

HAYWARD GALLERY
South Bank, S.E.1.

INSTITUTE OF CONTEMPORARY ARTS
Nash House, Carlton House Terrace, S.W.1.

NATIONAL GALLERY
Trafalgar Sq., W.C.2.

SERPENTINE GALLERY
Kensington Gardens, W.2.

TATE GALLERY
Millbank, S.W.1.

WALLACE COLLECTION
Manchester Sq., W.1.

NATIONAL PORTRAIT GALLERY
St. Martin's Place, W.C.2.

ROYAL ACADEMY OF ARTS
Piccadilly, W.1.

WHITECHAPEL ART GALLERY
Whitechapel High St.

Antique Markets

ANTIQUARIUS
Flood St., S.W.3.

ANTIQUE HYPERMARKET
Kensington High St.

CAMDEN LOCK
Chalk Farm Rd., N.W.1.

CAMDEN PASSAGE
Islington High St., N.1.

CHELSEA ANTIQUE MARKET
King's Rd., S.W.3.

PORTOBELLO RD., W.11.

Museums

BEAR GARDENS MUSEUM
Bankside, S.E.1.
11 a.m.-4 p.m.

BETHNAL GREEN MUSEUM
Cambridge Heath Rd., E.2.

THE BRITISH MUSEUM
Gt. Russell St., W.C.1.

GEFFRYE MUSEUM
Kingsland Rd., E.2.

GEOLOGICAL MUSEUM
Exhibition Rd., S.W.7.

IMPERIAL WAR MUSEUM
Lambeth Rd., S.E.1.

MUSEUM OF LONDON
London Wall, E.C.2.

MUSEUM OF MANKIND
Burlington Gdns., W.1.

NATIONAL ARMY MUSEUM
Royal Hospital, S.W.3.

SCIENCE MUSEUM
Exhibition Rd., S.W.7.

VICTORIA AND ALBERT MUSEUM
Cromwell Rd., S.W.7.

WELLINGTON MUSEUM
Apsley House, Piccadilly, W.1.

Attitude Questionnaire

This task was extended from J. Short's (1972) original experiments with two person discussion. The usefulness of the task is that changes in opinion may be measured using attitudes which often will have been deeply considered at some stage in the subject's life. The discussions which follow may be very animated. This task was only used over the week-long trials. Early in the week each conferee individually completes an attitude questionnaire while isolated from the others. In this questionnaire, the participant must decide upon a value of agreement along an eleven point scale, ranging from strongly agree to strongly disagree. Later, issues where there is likely to be disagreement are chosen as discussion topics, each one lasting as long as it takes to arrive at an agreed decision. At the end of the week the whole questionnaire is again presented and is completed individually.

NAME:_____ GROUP:_____

DATE:_____

ANSWER SHEET: A B SHEET 1

ATTITUDE QUESTIONNAIRE

1. That the wearing of safety belts in cars should be compulsory is an unwarranted infringement of individual liberty.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

2. Scientists should not be expected to answer the issues that arise out of their work; that is up to society.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

3. Public transport in large towns should be heavily subsidised out of taxation to discourage the use of the private car.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

4. University research bears too little relation to the practical problems of society.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

5. Art galleries should be financed by those who use them rather than the taxpayer in general.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

6. Students should be financed by loans rather than grants.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

7. Cars should be taxed according to mileage -- that is according to the use of facilities.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

8. The contents of the national museums should be expertly copied and the originals sold for charity.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

9. Centralised data banks pose an unwarranted danger to freedom.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

10. A knowledge of one's country's history is an indispensable part of everybody's education.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

11. It is inconsistent that marijuana but not tobacco should be illegal on health grounds.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

12 Blood sports like foxhunting and fishing are cruel and should be forbidden.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

13 Wars do the world some good.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

14. The practical man is of more use to society than the thinker.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

15 Immediate active steps are required to contain the rising population of this country.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

16 Intelligent people should be encouraged to have more children as this would increase the intellectual level of the population.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

17 Foreign languages are inadequately taught in this country.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

18 Individual privacy is unnecessary in a truly civilised society.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

19 The money spent on investigation of the moon could be more fruitfully spent elsewhere.

strongly disagree 1---1---1---1---1---1---1---1---1---1---1---1---1 strongly agree
1 2 3 4 5 6 7 8 9 10 11

Enhancement of Dominant Attitudes (EDA) or Risky Shift tasks

Three items in this series of tasks are from Kogan and Wallock's (1964) choice dilemma questionnaire and these had been already modified for use with British subjects by Champness (1972). A fourth task was also added by the research team. These tasks were chosen specifically to investigate the processes in meetings whereby decisions must be made with some level of risk involved. These consist of a number of situations where a hypothetical person must choose between two alternative course of action. One alternative is more desirable and attractive than the other, but the probability of achieving or attaining this one is less than the probability of achieving or attaining the second. It is necessary to indicate the minimum odds of success you would demand before recommending that the more attractive alternative be taken.

The participants firstly write down a recommendation individually and then as a group after discussing the issue.

E.D.A. INSTRUCTIONS

On the sheet of paper you will find a situation that is likely to occur in everyday life. The central person in the situation is faced with a choice between two alternative courses of action, one alternative is more desirable and attractive than the other. But the probability of acheiving or attaining one is less than the probability of acheiving or attaining the second.

I would like you to indicate the minimum odds of success you would demand before recommending that the more attractive or desirable alternative be chosen. Read the situation carefully before giving your judgement. Try to place yourself in the position of the person in the situation. When you have decided the position you would like the person to take, I will ask you individually over the private system for your recommendation.

I would then like you to discuss the problem and arrive at a group course of action for the person in the situation. However, and this is very important, do not tell the other participants of your initial recommendation.

Mr. L, a married 30 year old scientific civil servant, has been appointed to a government research laboratory. He is offered the chance to work for the next five years on a difficult, long-term problem which, if a solution could be found, would resolve basic scientific issues in the field, and bring high scientific honours. If no solution were found, however, Mr. L. would have little to show for this next five years in the laboratory, and this would make it hard for him to obtain a better position afterwards. On the other hand, he could, as most of his colleagues are doing, work on a series of short-term problems where solutions would be easier to find, but where the problems are of lesser scientific importance.

Imagine that you are advising Mr. L. Listed below are several probabilities or odds that a solution would be found to the difficult, long-term problem that Mr. L has in mind.

Please tick the lowest probability that you would consider acceptable to make it worthwhile for Mr. L to work on the more difficult long-term problem.

_____ The chances are 1 in 10 that Mr. L would solve the long-term problem

_____ The chances are 3 in 10 that Mr. L would solve the long-term problem

_____ The chances are 5 in 10 that Mr. L would solve the long-term problem

_____ The chances are 7 in 10 that Mr. L would solve the long-term problem

_____ The chances are 9 in 10 that Mr. L would solve the long-term problem

_____ Please tick here if you think Mr. L should not choose the long-term, difficult problem, no matter what the probabilities

Mr. A, an electrical engineer, who is married and has one child, has been working for a large electronics company since graduating from college five years ago. He is assured of a lifetime job with a modest, though adequate, salary, and liberal pension benefits upon retirement. On the other hand it is very unlikely that his salary will increase much before he retires. While attending a conference, Mr. A is offered a job with a small, newly founded company which has a highly uncertain future. The new job would pay more to start and would offer the possibility of a share in the ownership if the company survived the competition of the larger firms.

Imagine that you are advising Mr. A. Listed below are several probabilities or odds of the new company's proving financially sound.

Please tick the lowest probability that you would consider acceptable to make it worthwhile for Mr. A to take the new job.

_____ The chances are 1 in 10 that the company will prove financially sound

_____ The chances are 3 in 10 that the company will prove financially sound

_____ The chances are 5 in 10 that the company will prove financially sound

_____ The chances are 7 in 10 that the company will prove financially sound

_____ The chances are 9 in 10 that the company will prove financially sound

_____ Please tick here if you think that Mr. A should not take the new job no matter what the probabilities.

Mr. C, a married man with two children, has a steady job that pays him about £4,500 per year. He can easily afford the necessities of life, but few of the luxuries. Mr. C's father, who died recently, carried a £2,900 life insurance policy. Mr. C would like to invest this money in stocks and shares. He is well aware of the secure 'gilt-edged' shares that would pay approximately 10% on his investment. On the other hand, Mr. C has heard that the stocks of a relatively unknown Company X might double their present value if a new product currently in production is favourably received by the buying public. However, if the product is unfavourably received, the stocks would decline in value.

Imagine that you are advising Mr. C. Listed below are several probabilities or odds that Company X stocks will double thier value.

Please tick the lowest probability that you would consider acceptable for Mr. C to invest in Company X stocks.

_____ The chances are 1 in 10 that the stocks will double their value

_____ The chances are 3 in 10 that the stocks will double their value

_____ The chances are 5 in 10 that the stocks will double their value

_____ The chances are 7 in 10 that the stocks will double their value

_____ The chances are 9 in 10 that the stocks will double their value

_____ Place a tick here if you think that Mr. C should not invest in Company S stocks no matter what the probabilities

Please tick one of each pair of alternatives, the alternative you would prefer.

i	A gift of 1p	OR	A 1 in 10 chance of 10p .....
ii	A gift of 10p	OR	A 1 in 10 chance of £1 .....
iii	A gift of £1	OR	A 1 in 10 chance of £10 .....
iv	A gift of £10	OR	A 1 in 10 chance of £100 .....
v	A gift of £100	OR	A 1 in 10 chance of £1,000 .....
vi	A gift of £1,000	OR	A 1 in 10 chance of £10,000 .....
vii	A gift of £10,000.....	OR	A 1 in 10 chance of £100,000.....
viii	A gift of £100,000.....	OR	A 1 in 10 chance of £MILLION.....

Maier assembly line problem

This task, which is adapted from Maier's (1950) Parasol Assembly Problem, was used because the two conflicting possible viewpoints, (those which consider economics must come first and those which feel the individuals are most important) give rise to a series of excellent discussions. There is potential for much negotiation, bargaining and coalition formation before the final decision is made. Answers cannot be evaluated but can be classified as being more or less person oriented. The 'human relations' problem involves a bottleneck in an assembly line, caused by a slow and ageing worker. The task is adapted for our purposes and takes place in three stages.

In the first stage, the four conferees play the role of group responsible for the generation of ideas which would solve the problem. In the second stage, they are divided into two groups, that representing the official side and that representing the union side. The former must adopt the role of maintaining production and profits, while the latter must guarantee the employment of the 'problem worker', Joe. The idea, which is agreed upon, is then presented to management, personnel and union representatives in the presence of Joe himself, in the third stage.

Assembly Line Problem

The Problem

Visualise the situation in which seven men, working in a circle, assemble part of a car, (carburettor or instrument panel, for example). The article enters the circle at one point, and each person adds his pieces and pushes the unit to the next worker who adds his elements. When the unit leaves the circle, it is a completed product, (fig. 1).

There are four sub-assembly stations, each one supervised by a foreman. Station A assembles 85 units per day; Station B 80 units per day: and Station D, 50 units. It is a fact that Station D previously assembled 60 units. The foreman was dissatisfied with the production and reprimanded the group. Following the reprimand, production fell to 50 units per day.

The assembly work is simple and requires a minimum of training for each step. The aptitude requirement is primarily good finger dexterity. The materials for each assembly position are located in bins which are kept supplied by material handlers. Thus each worker has his essential material at his elbow. The job has been analysed by time and motion experts, so that the positions are of equal difficulty. Pay is based on hourly rates.

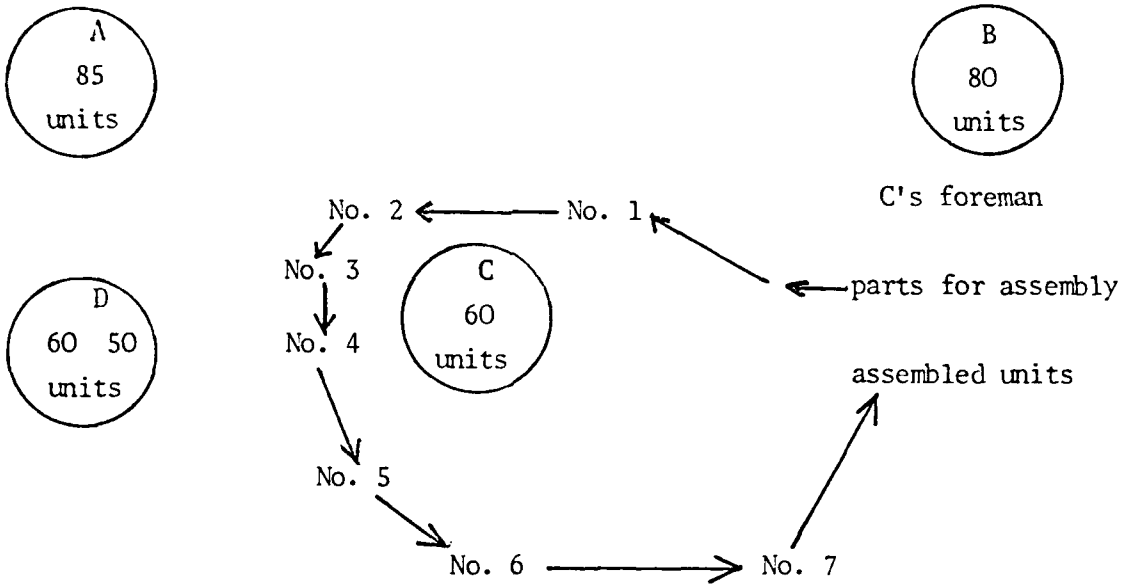
Total factory production is dependant upon receiving the required number of assembled units from these four stations. The production is now so low that the factory production as a whole has had to slow dowr. The desired quota is 300 parts per shift for the four stations combined.

We are concerned with Station C producing at the rate of 60 units. The work piles up at the position of Joe Brown. The unit must pass through him, (position 3), and he always has several piled up waiting for him. Foremen on non-production jobs are not willing to accept Joe as a transfer. Joe is a man of 60 with 30 years service in the company. Emphasis on improving production has brought his deficiencies to light. Joe is a nice congenial fellow. Although slow and unhandy, he is liked by the group of workers, who while realising that he is holding things up, do not blame him for it. There is occasionally some friction, however. He is a bit of a loner, but this may be because he is somewhat older than the other workers.

Your task is to agree on the most satisfactory solution to the problem.

Assembly Line Problem

Figure 1.



ANSWER SHEET

1. Please write down the solution upon which you agreed: _____

_____

_____

_____

_____

_____ _____

2. How satisfied are you with the solution?

- ☐ very satisfied
- ☐ fairly satisfied
- ☐ neither satisfied nor dissatisfied
- ☐ fairly dissatisfied
- ☐ very dissatisfied

3. What proportion of the time would you say you spent:

a) Evaluating the facts of the problem....., _____

b) Disagreeing about the merits of possible solutions.... _____

c) Agreeing about the merits of possible solutions..... _____

d) Other activities..... _____

TOTAL 100%

Spinoff

This task, which is commercially packaged, is itself based on decisions which must be made while choosing a particular teleconference system. It is here adapted for four participants. Each plays the role of a differently motivated member of a consortium, which must decide upon one common communications network, which would satisfy all their needs for a faster, reliable system.

SPINOFF

BACKGROUND INFORMATION

In the early 1940's, the seperate organisations were small, struggling organisations. In 1947, they began exploring the advantages of cooperating. And in 1950 they became a Consortium. This arrangement turned out to be more successful than anyone anticipated. It increased the capability of each organization at very little expense. There is no doubt in anyone's mind that the Consortium has made each organization more effective. But as the organizations have each developed their own strengths, there has been some growing pains. According to the members of the Consortium, there's no lack of effort, goodwill, or skill. But there are problems due to the lack of fast, reliable communication among the various groups. The Communications Committee, was set up to investigate the options for improving communication. Now the Consortium must make a choice.

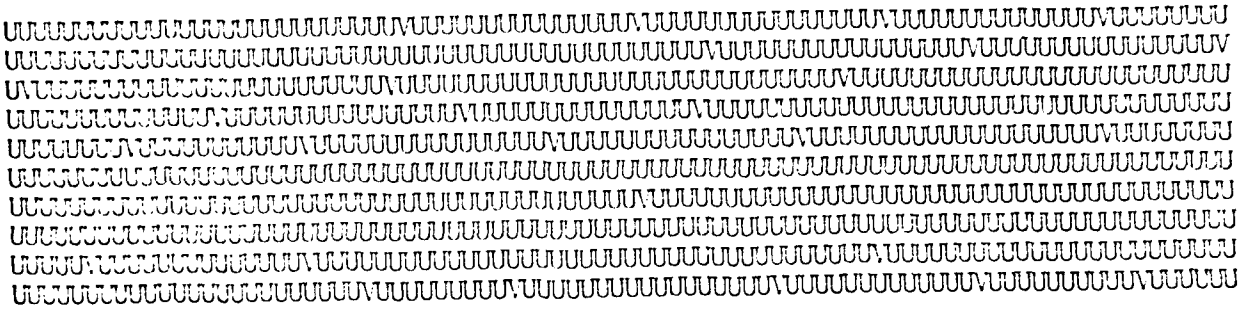
YOU HAVE INFORMATION SHEETS. PLEASE STUDY THEM CAREFULLY BEFORE THE MEETING BEGINS.

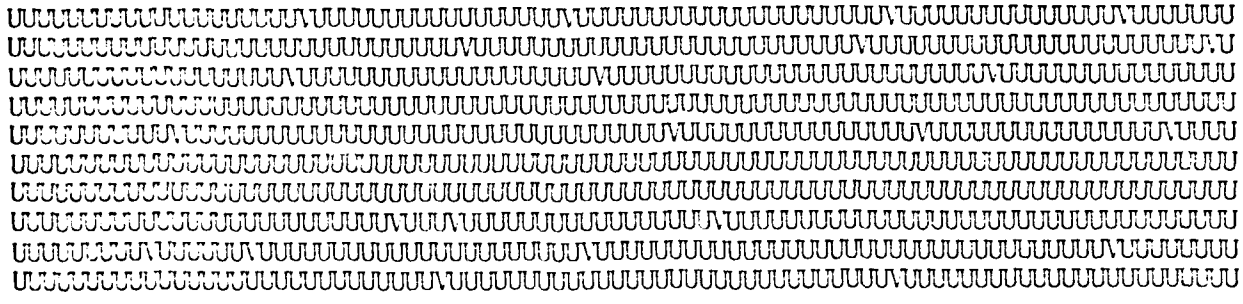
The Perceptual Motor Task

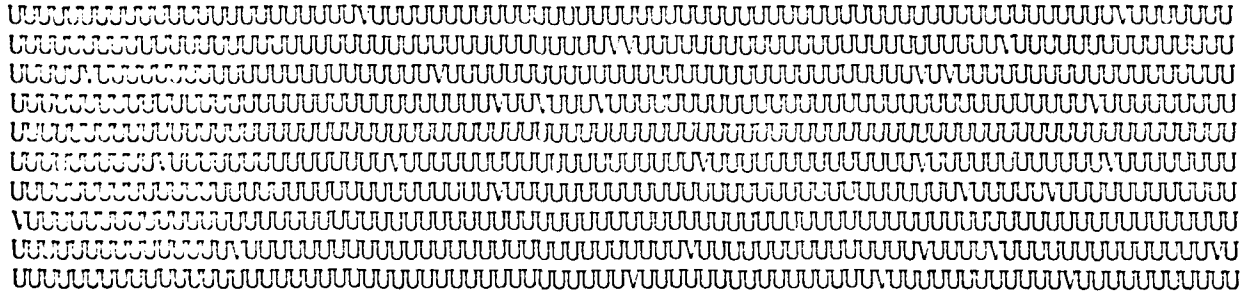
This task uses a simple perceptual skill to give a measure of alertness. Participants have to detect and ring a number of 'V's which are hidden amongst 50 rows of 'U's. This task was presented at six stages during the day, with the order of rows changed on each occasion. They have two minutes to circle as many 'V's as they can.

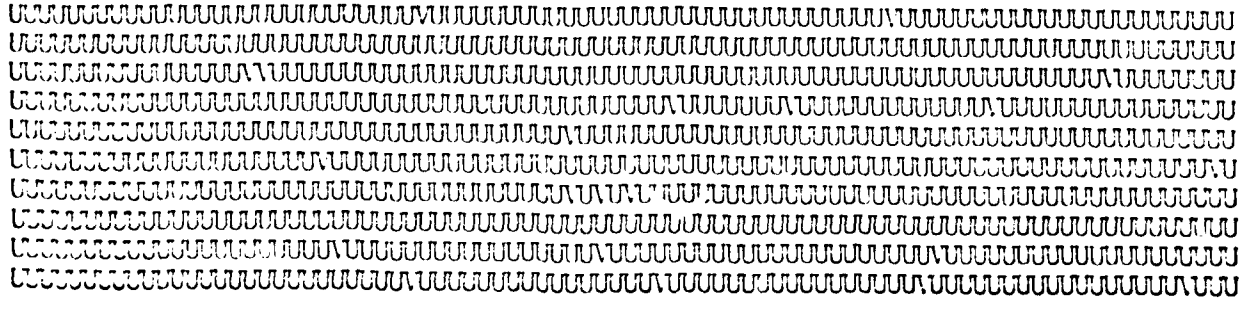
Two aspects are measured. Firstly the speed with which the participant is able to scan the lines looking for 'V's, and in addition, the number of 'V's missed as the participant moves down the page. The speed or number of lines scanned is a general measure of the learning curve associated with the task. The percentage of ringed 'V's to those missed is the measure of alertness. In such a way it is posible to examine the pattern of alertness over a day.

Name: _____ Date: _____









The Town Planning game

The Town Planning game combines both an analytical problem with an abundance of information. Participants must choose which data is relevant. Evaluation will become possible in the future since this is a real problem being presently faced by planning officers. This task was developed using information gathered by the planning department of the London Borough of Southwark, England. This borough is notable in that the movement of associated industries away from the old docklands has resulted in the gradual movement of people away from the borough. The planning department was concerned about the falling standards of the large shopping areas, no longer able to be supported by a falling population. Market forces would have, in time, created a new balance of supply and demand, but in the meantime standards were dropping severely with shops keeping their stock to a minimum.

The game concerns itself with one discrete sector, that of chemist shops. The participants are asked to consider where they, as a planning consultancy, would recommend that chemists should be relocated. These chemists would be compensated and given sites in areas of growth outside the Borough. A competitive element was added by also making each participant responsible for three planning areas within the Borough. As elected representatives of these areas, it is their duty to maintain the number of shops in their particular neighbourhood.

Procedure

The conferees are each given a set of instructions and four information sheets. Further information describing more fully the population, the shopping areas, the types of shops and any measured trends are available to be viewed on their documents monitors. They have one hour to give six possible chemists, ranked in order of priority.

Evaluation

The game is set in 1978, using data from 1976. We therefore found the positions of all chemists which had closed or opened since 1978 and compared these with the answers given. Unfortunately nobody predicted exactly where these chemists closed, all were equally good. This made the ranking of answers impossible. Probably the effect of chemists closing for reasons other than low demand was too critical over the short time span of 2 years. However, as time passes and more people use this task, evaluation will become more effective.

THE TOWN PLANNING GAME

SOUTHWARK

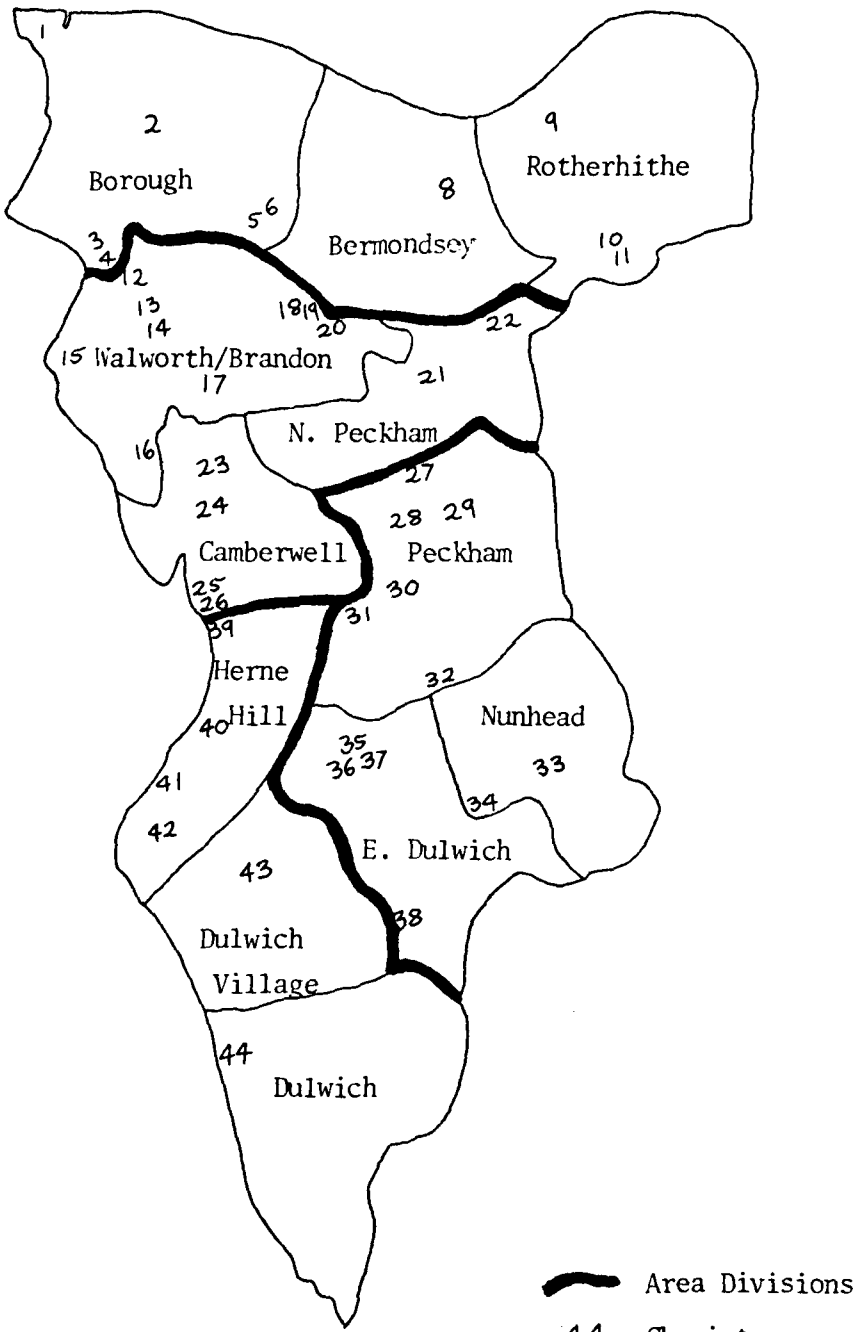
An independant planning consultancy has advised, in the light of a worsening economic climate and a reduced local population, the closure of six chemists in the London Borough of Southwark. This would enable the remaining chemists to again provide the high quality of service which for the last few years they have been unable to give. Each of you, while individually responsible for three areas, make up this board responsible for the identification of six chemists, the removal of which would result in the least inconvenience. Such shops would be reimbursed and helped establish themselves elsewhere.

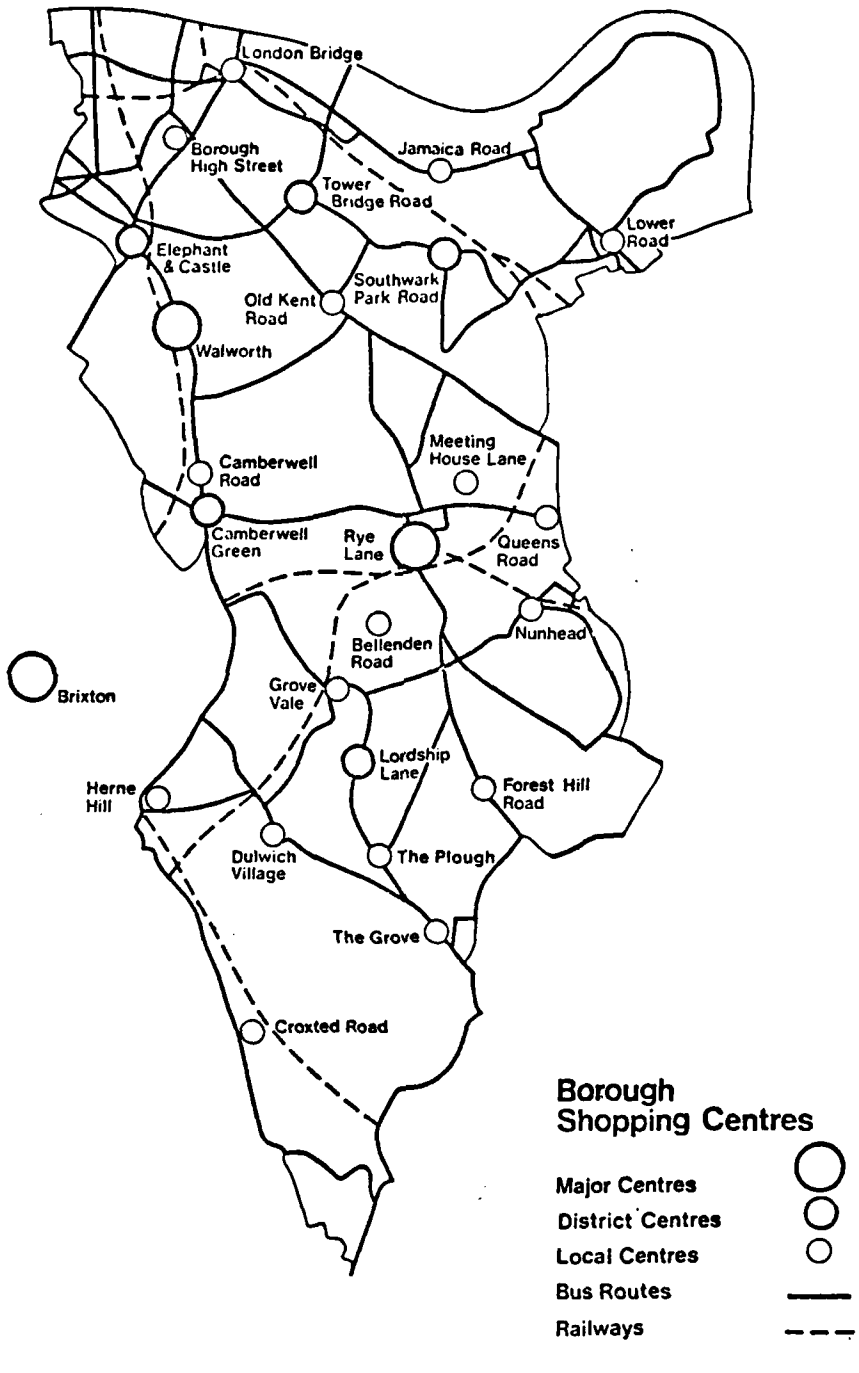
Information from a 1976 survey has been distributed. Further more detailed information is available for viewing on the screen in front of you.

You will now have forty minutes to select the six chemists. You should rank these in order of your increasing confidence about their undesirability.

You should,however,remember your own responsibility to three areas,in particular. Reductions in the number of chemists within your own area should be minimised so as to not harm your individual popularity in the next council elections.

Planning Districts and Chemists In Southwark




London Bridge
Borough High Street
Jamaica Road
Tower Bridge Road
Lower Road
Elephant & Castle
Southwark Park Road
Old Kent Road
Walworth
Meeting House Lane
Camberwell Road
Camberwell Green
Rye Lane
Queens Road
Nunhead
Bellenden Road
Brixton
Grove Vale
Lordship Lane
Herne Hill
Forest Hill Road
Dulwich Village
The Plough
The Grove
Croxted Road
Borough Shopping Centres
Major Centres
District Centres
Local Centres
Bus Routes
Railways

Information Distributed on Paper and Available for Viewing on Screen

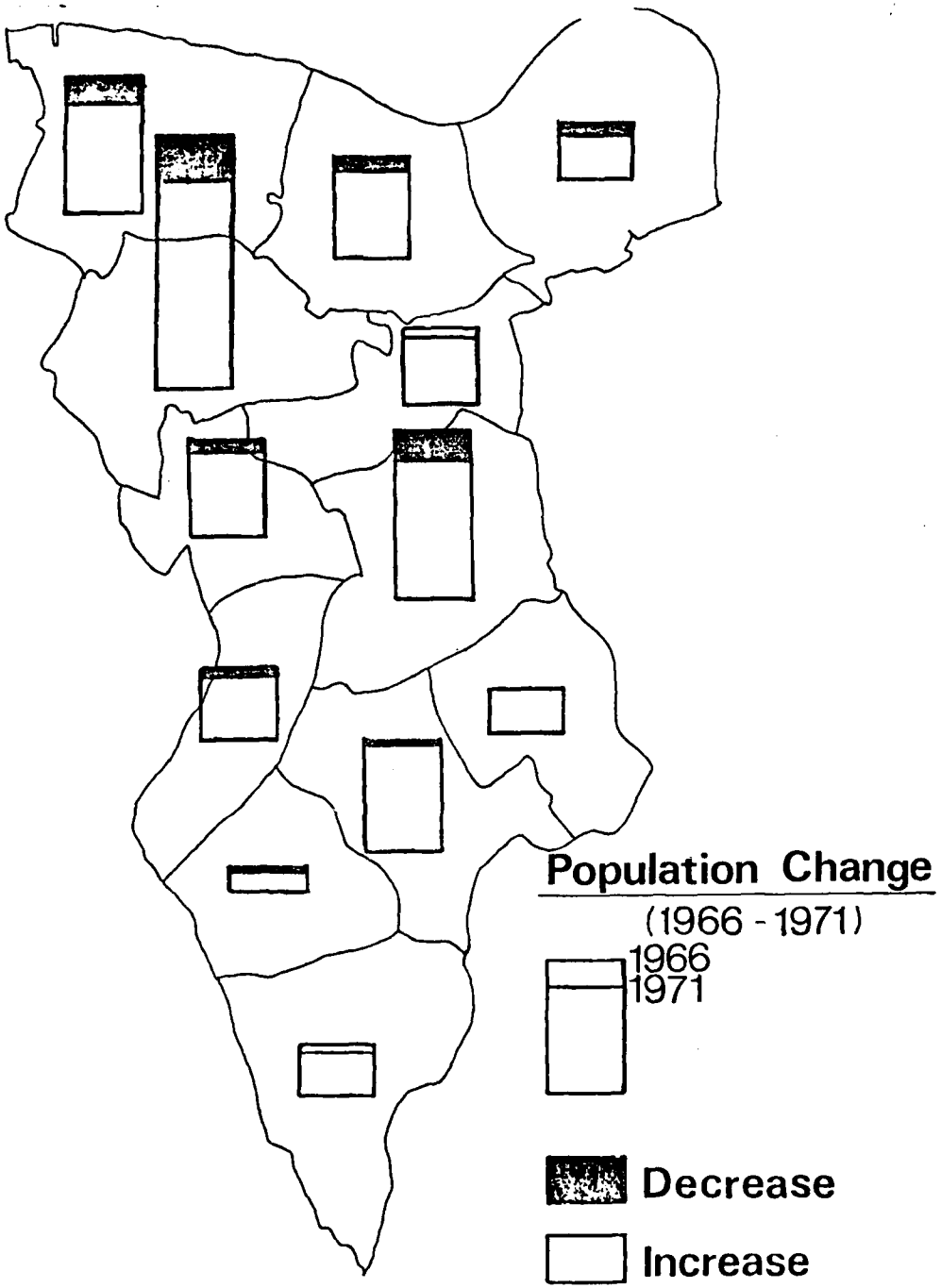
1. Existing shops (size and growth)
2. Existing population (size and growth)
3. Results of survey about satisfaction of shoppers
4. Predicted future percentage growth of population

Information Available for Viewing on Screen Only

5. Actual predicted future growth of population
6. Actual existing population size and growth
7. Estimates of regional variations in income
8. Changes in relative proportion of age groups
9. Types of existing shops
10. Types of bus routes
11. Location of new developments (1971 - 1981)
12. Location of demolitions (1971 - 1981)

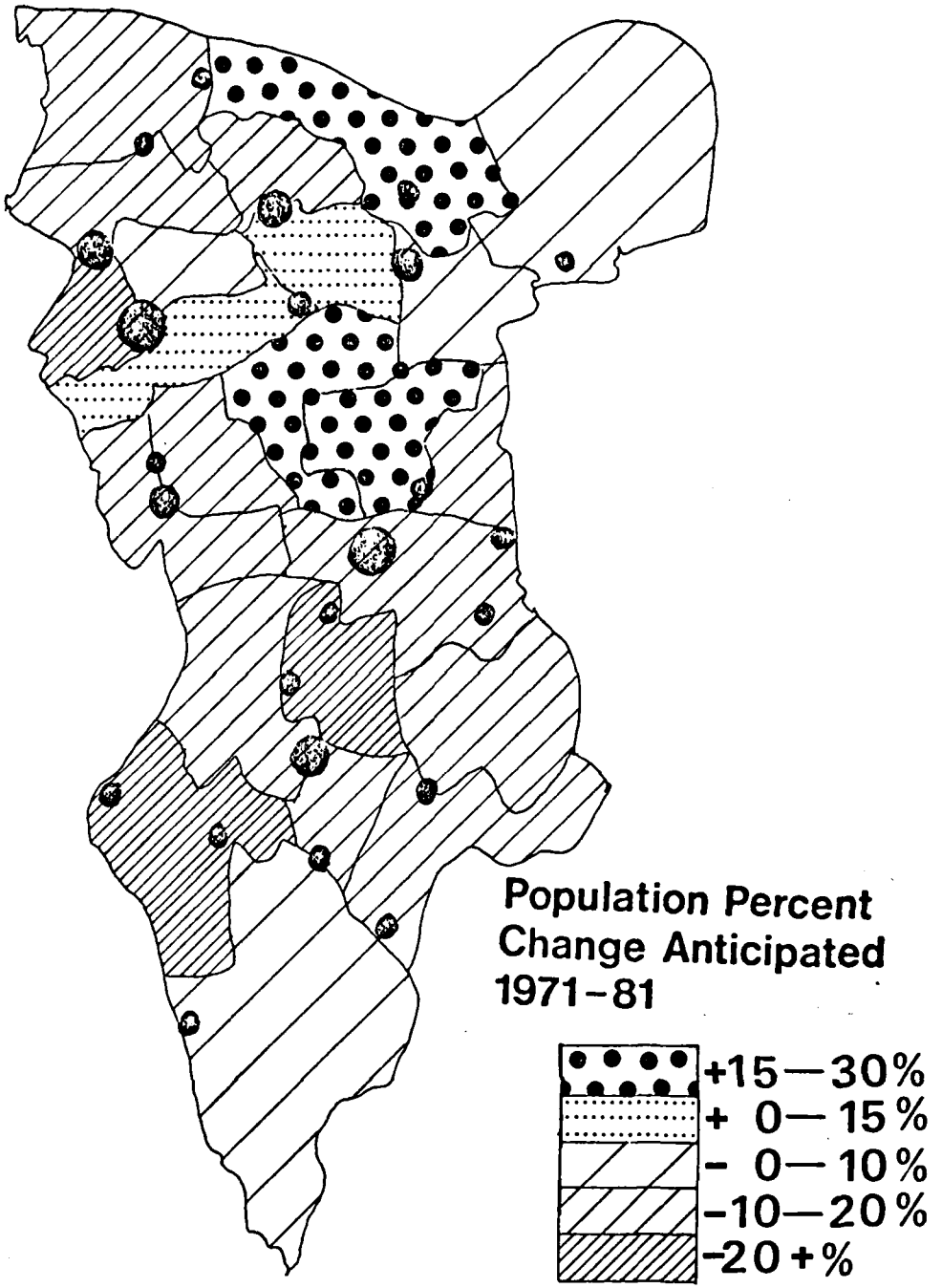
Changes in Shopping Floorspace

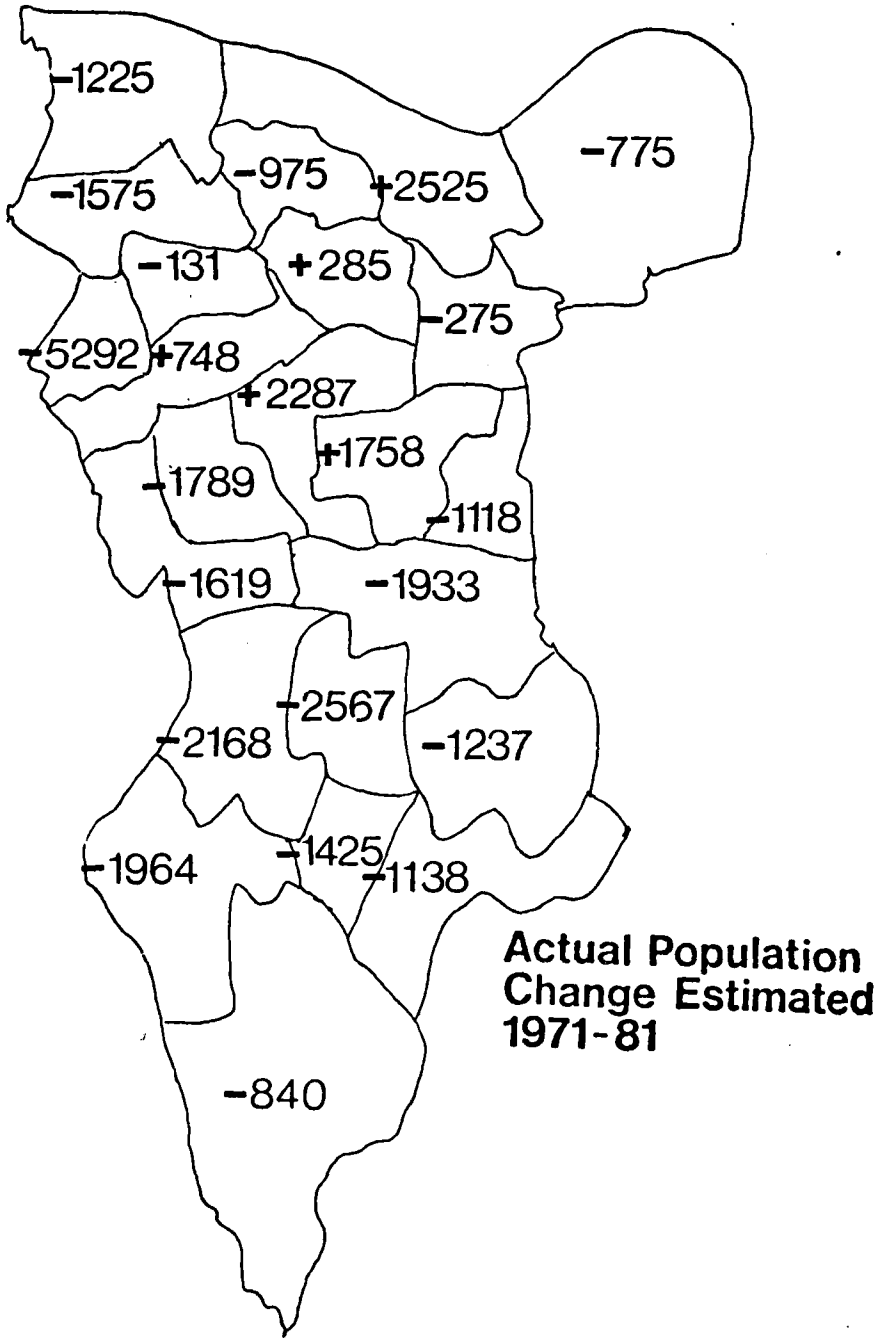
District	% 1966	% 1976	% Change
Borough	17.4	14.9	-38
Bermondsey	8.5	6.3	-46
Rotherhithe	3.3	4.1	-11
Walworth / Brandon	25.3	23.3	-34
North Peckham	4.7	3.4	-46
Camberwell	7.3	6.8	-33
Peckham	21.4	27.1	- 9
Herne Hill	1.8	2.3	- 9
Nunhead	1.6	1.7	-23
East Dulwich	6.3	6.8	-23
Dulwich Village	1.0	1.3	- 8
Dulwich	1.3	1.9	+ 5
Borough Total:	100%	100%	-28


Population Change
(1966 - 1971)
1966
1971
Decrease
Increase

Shoppers were asked in 1975 what were the facilities they considered lacking. The following table shows what percentage of the people interviewed considered each category inadequate. Only the information for these four regions is available.

% Dissatisfied	Borough 67%	Rotherhithe 55%	N. Peckham 46%	Herne Hill 56%
Chemists	32%	12%	20%	9%
Supermarkets	19%	18%	7%	8%
Butcher	9%	11%	3%	4%
Fishmonger	6%	4%	9%	13%
Other food	19%	8%	9%	8%
Multiples	6%	9%	1%	3%
Clothes/Shoes	12%	11%	7%	13%
Launderette	8%	4%	1%	2%
Post Office	1%	10%	11%	6%
Other	10%	10%	8%	13%


Population Percent
Change Anticipated
1971-81
+15—30%
+ 0—15%
- 0—10%
-10—20%
-20+%

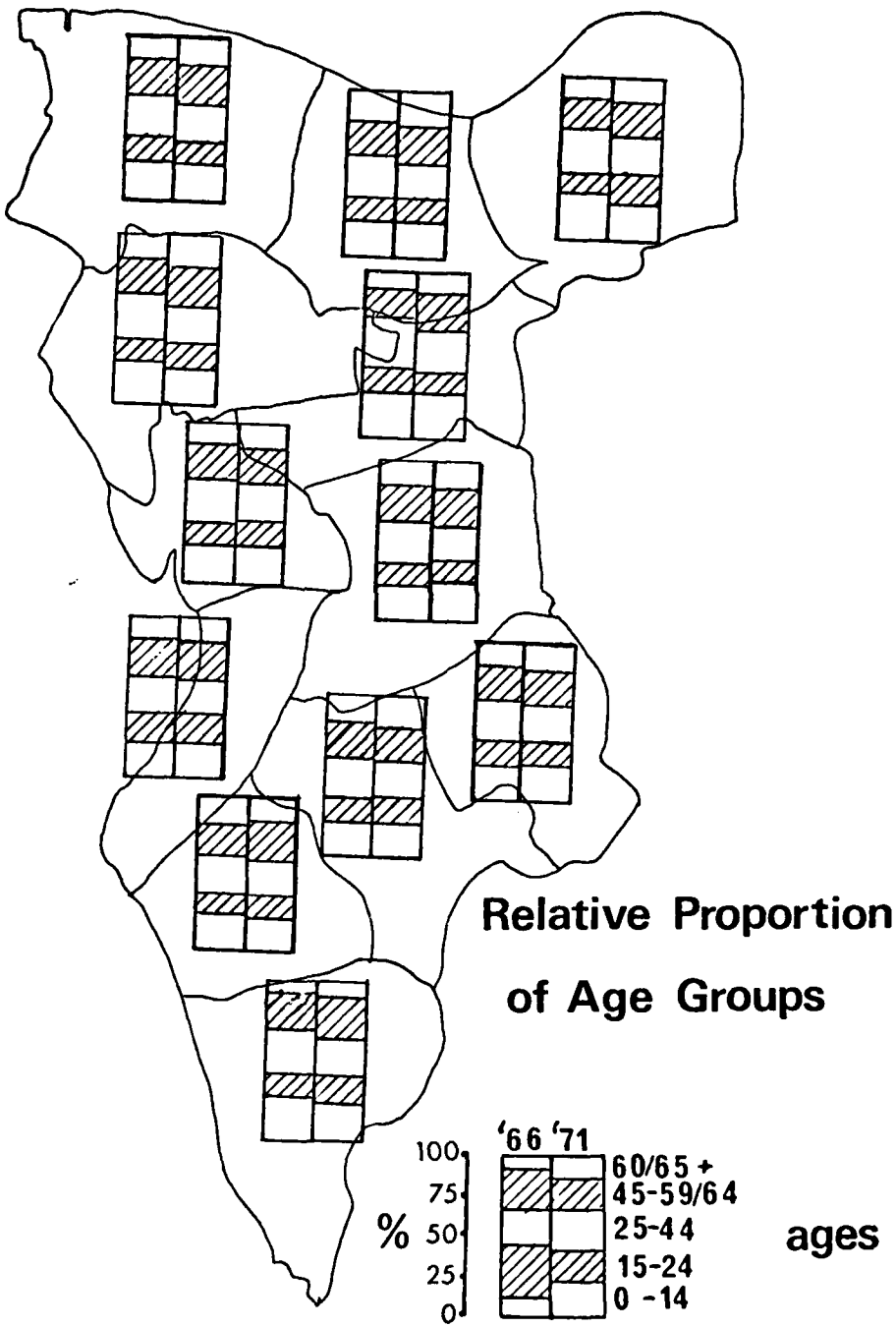

-1225
-775
-975
+2525
-1575
-131
+285
-275
-5292
+748
+2287
+1758
-1789
-1118
-1619
-1933
-2567
-2168
-1237
-1964
-1425
-1138
-840
Actual Population
Change Estimated
1971-81

Population in Private Households (1971) and Percentage Change 1966-71

	1971 (Number)	% change 1966-1971
Borough	28,000	-18.5
Bermondsey	22,000	-14.1
Rotherhithe	12,000	- 4.2
Walworth + Brandon	51,000	-18.5
N. Peckham	18,000	+ 7.8
Camberwell	23,000	- 5.0
Peckham	34,000	-19.1
Herne Hill	16,000	- 3.7
Nunhead	11,000	0.0
E. Dulwich	27,000	- 7.2
Dulwich Village	5,000	- 5.0
Dulwich	9,000	+ 5.0
Southwark	255,000	-11.2

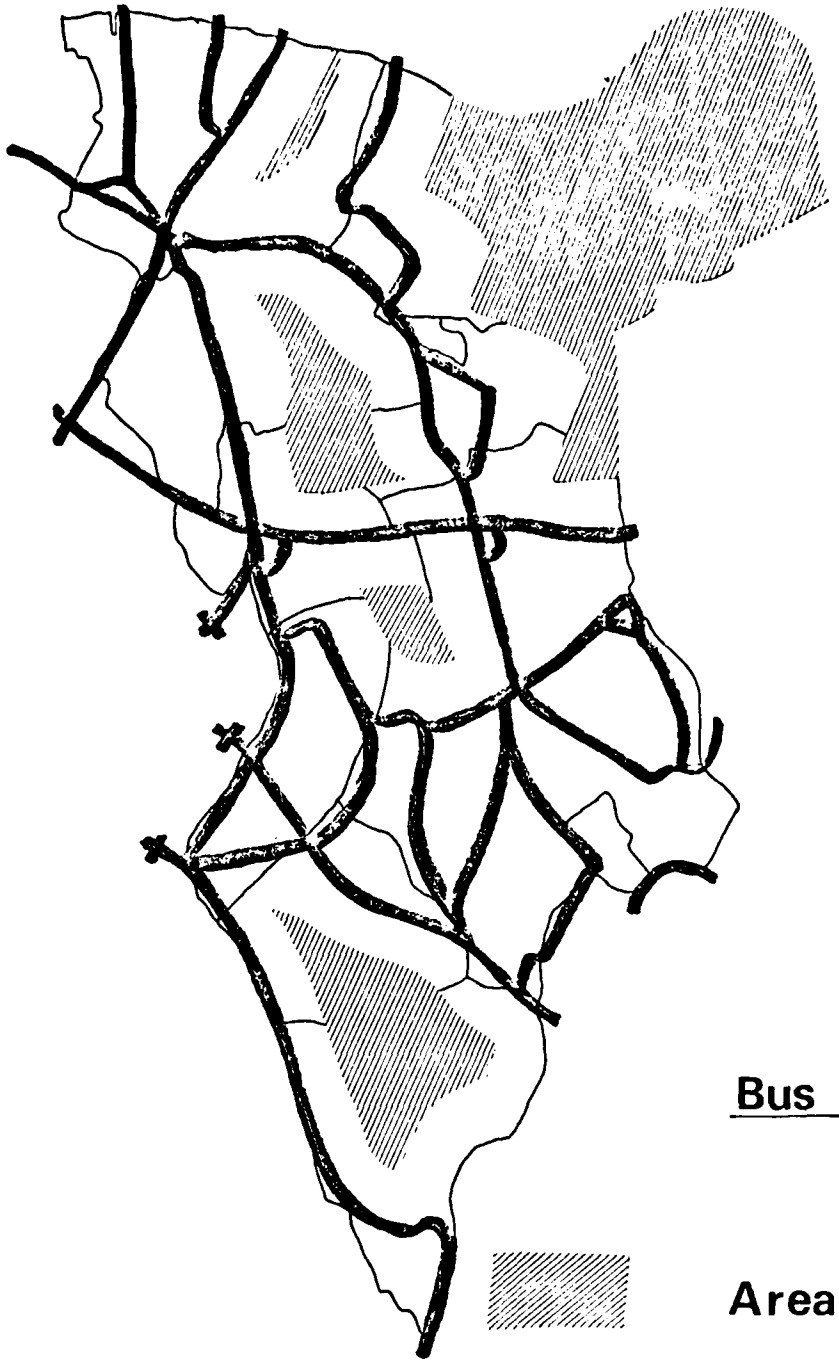
Estimates of Income from 1975 Household Survey

Districts	Head of household's mean income	% Households earning up to £750 p.a.	% Households earning up to £1500 p.a.	% Households earning more than £4000
Borough	1612	12	45	9
Bermondsey	1807	9	36	16
Rotherhithe ..	1671	8	33	15
Walworth / Brandon	1913	9	27	17
North Peckham	1962	3	23	12
Camberwell ...	1818	10	34	21
Peckham	1821	13	38	13
Herne Hill	2306	4	25	26
Nunhead	2154	4	21	15
East Dulwich	2025	4	32	18
Dulwich Village & Dulwich	3342	2	23	36


Relative Proportion
of Age Groups
'66 '71
100
75
%
50
25
0
60/65 +
45-59/64
25-44
15-24
0 -14
ages

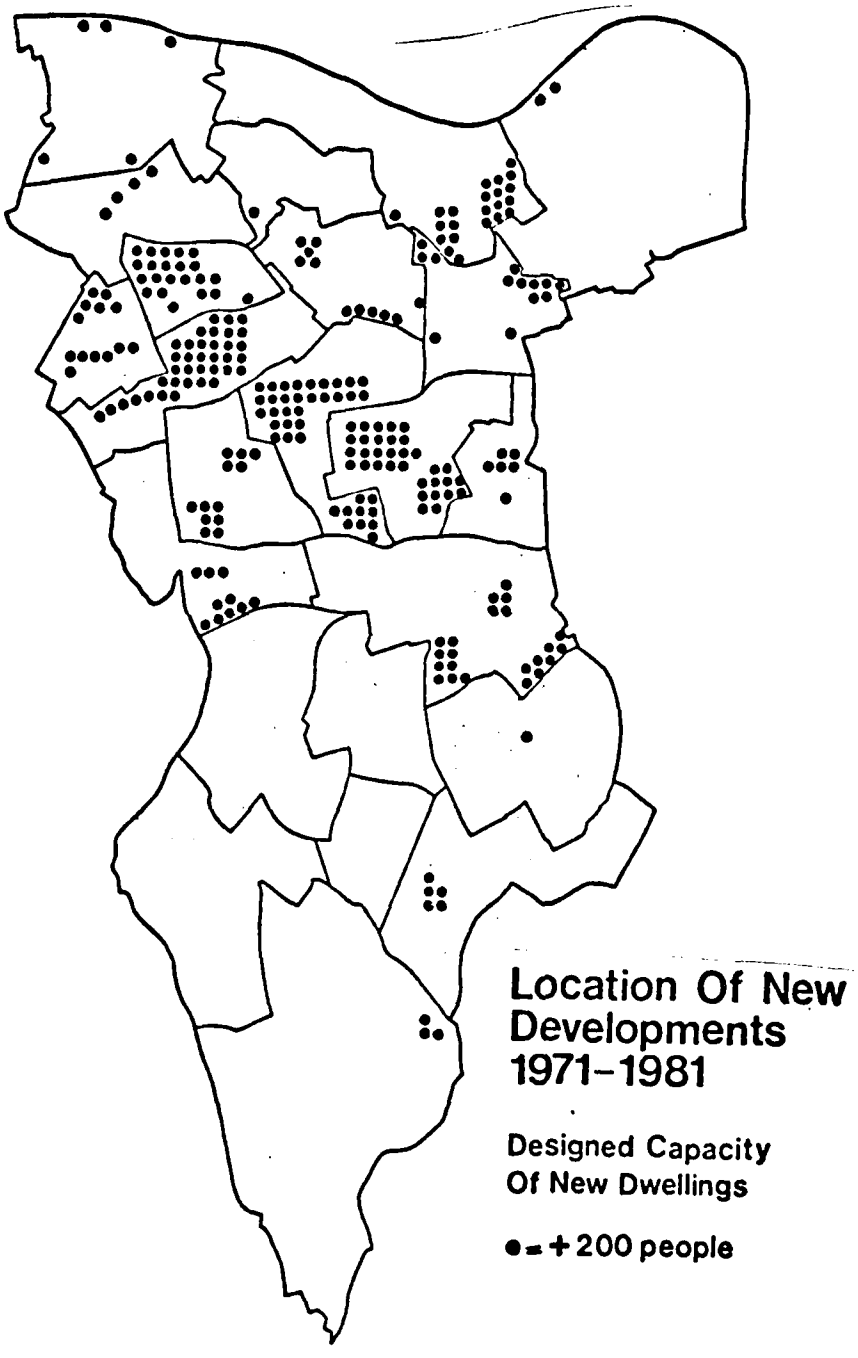
Types of Existing Shops

	No. of Shops	Convenience (Food, Papers)	Durable (Clothes)	Services (Repairs)
Rye Lane	294	24%	67%	9%
Walworth Rd.	132	21%	72%	6%
Camberwell Green	86	42%	49%	9%
Lordship Lane	91	34%	54%	12%
Elephant & Castle	33	33%	55%	12%
Southwark Park Rd.	56	34%	54%	12%
Tower Bridge Rd.	103	39%	48%	1%
Old Kent Rd.	106	28%	55%	17%
Jamaica Rd.	47	43%	36%	21%
Lower Rd.	51	41%	43%	16%
London Bridge	26	38%	58%	4%
Grove Vale	29	35%	48%	17%
Queens Rd.	20	50%	35%	15%
Barry Rd.	28	54%	32%	14%
Nunhead	26	55%	42%	4%
Bellenden Rd.	26	42%	42%	16%



Bus Routes

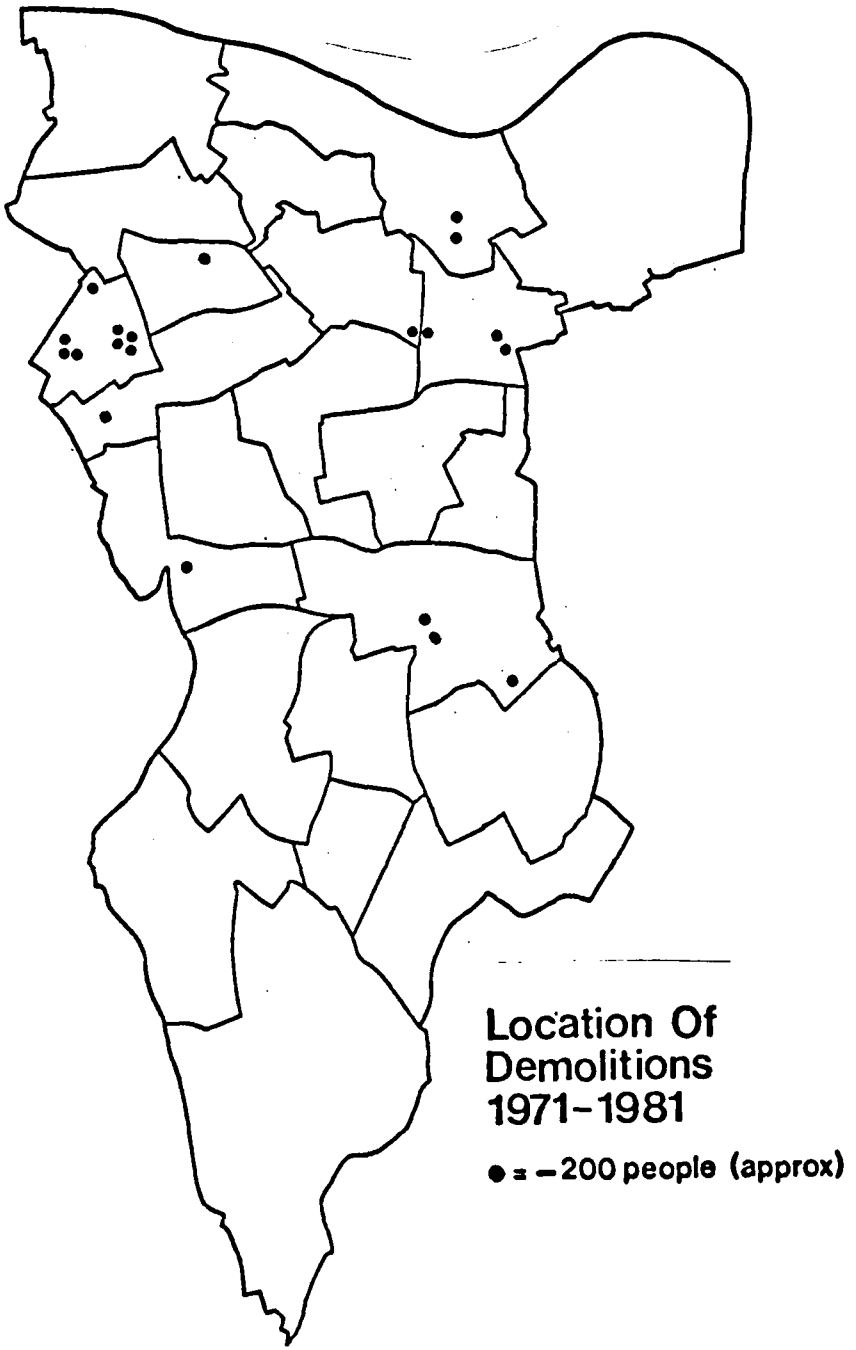
Areas 1/4 Mile From a Route



Location Of New Developments 1971–1981

Designed Capacity
Of New Dwellings

● = + 200 people


Location Of
Demolitions
1971-1981
● = ~200 people (approx)

ANNEX B 2 TELECONFERENCE PARTICIPANTS

ANNEX B2 TELECONFERENCE PARTICIPANTS

To ensure that any findings are relevant, it is necessary to recruit as subjects people similar to those who may finally use a teleconference system. We therefore enlisted people accustomed to taking part in meetings such as civil servants and senior or middle management personnel from private companies. The tasks selected allowed us to use people from all types of work, since little specialized knowledge is necessary. Examples of the types of companies who cooperated are shown in Figure B.3.

The first phase of the research involved people visiting at lunchtime our teleconference suite in the centre of London. These people were recruited using the brochure, included in this appendix. This brochure was mailed to the personnel or telecommunications managers of organizations based in London. Meetings were arranged with those respondents who completed the pre-paid post card at the back of the brochure. Participants spent 40 minutes on a task followed by a free meal and an extensive but informal debriefing session. In the second phase, we used groups of four people who could be temporarily employed in our office for four consecutive days. These people were recruited using an advert placed in the Guardian newspaper. The advantage here was that they were able to complete a wide range of tasks and repeat a given task on a number of days using different equipment or procedures. In addition, throughout the research period, real meetings, both internal and some organized by outside companies, took place over the teleconference system. The numbers of participants or participant hours are shown in Figure B.4.

FIGURE B.3 LIST OF PARTICIPANTS' COMPANIES OR ORGANIZATIONS

Midland Bank
The Post Office
British Gas Corporation
Electricity Council
Commission for Racial Equality
HM Treasury
Overseas Development Administration
British Airports Authority
Arts Council
National Freight Corporation
Office of Population Censuses and Surveys
Thames Water Authority
Whitbread Brewery
R. Seifert and Partners (Chartered Architects)
British Library
Central Office of Information
Plymouth Polytechnic
Department of Health and Social Security
Dentsu (Japan)
Central Electricity Generating Board
Design Magazine
British Waterways Board
Metropolitan Police
Central London Polytechnic
Televerket
Home Office
The Civil Service Department

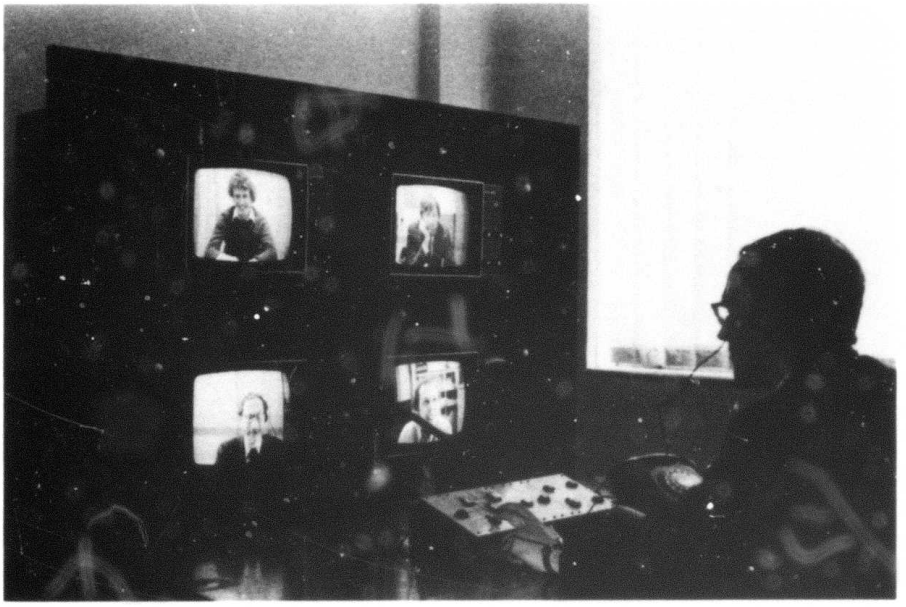
FIGURE B.4 USE MADE OF THE TELECONFERENCE SYSTEM DURING THE RESEARCH PERIOD

	Participants
Lunchtime sessions	113
Week long sessions	530 (participant hours)
External or internal real meetings	500 (participant hours)
	1143

The Recruitment Brochure

TELECONFERENCE

DECISION MAKING



YOU CAN'T BUY THIS BUT...

Communications Studies and Planning Ltd

You can help to design it

C.S. & P are currently looking for people to participate in a research project funded by the U.S. Government. They want to improve decision making amongst their senior defence personnel by using teleconferencing: an audio video meeting of geographically separated participants. We want people who have practical experience of decision making in their work to use this system and help in its development.

How?

By being involved in a group discussion with three other people like yourself. Using this equipment you will be asked to evaluate a problem and reach a decision. An example of the sort of problem you could expect would be to design a day tour of London for a foreign client and his family ... A case of wine will be given to the best group decision after each ten weeks of discussions. These discussions will be held via a teleconference system centrally co-ordinated by a controller who will also be able to provide factual information to help you in your decision making.

After each conference you will be asked for:

- your reaction to the task
- the decision made
- your impressions of the facilities you used

These reactions and your recorded comments will provide the basis for our analysis.

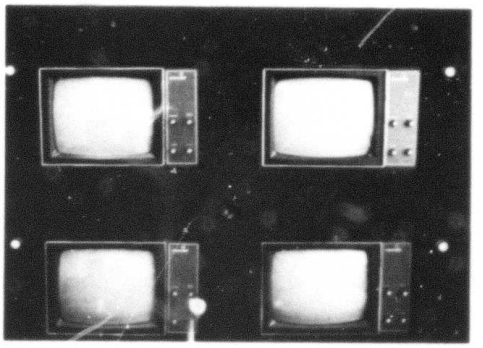
For an hour of your time

You will be able to use an example of future modern technology. Sessions will end with a free lunch with wine when we can chat informally about your impressions.

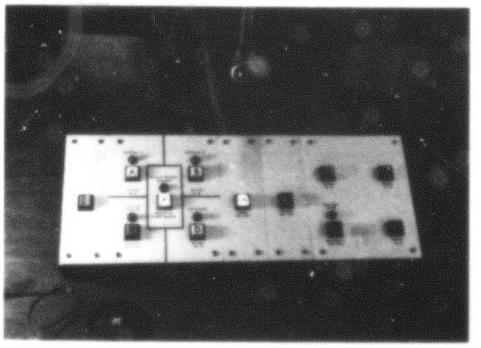
We will be constantly redesigning the system using your comments, criticisms and ideas.

The facilities

This is the new teleconference system you will be using:



It is designed so that you can both hear and see each other. Facilities will be available to allow you to request information and store messages.



What you should do

We would appreciate your participation in a single visit although we would like to establish a group of participants willing to attend more than one session.

If you would like to participate in this new and original research please complete the card at the bottom of the page with your name, telephone number, occupation and availability.

Your assistance in this project would be most appreciated, and we hope the research will prove mutually beneficial.

If you have any further enquiries regarding the project, please do not hesitate to contact us: Jim Birrell or Pat White on 01-631 1119

What we do

Communications Studies and Planning Ltd. (CS & P) is an international consultancy specialising in communications and information technology. It offers consulting and research services to suppliers and users of these technologies, including governments and telecommunications carriers, and contributes to the formulation of public telecommunications policy.

Background

The founder members of CS & P Ltd pioneered the development of teleconference research in the early 1970's as part of Communications Studies Group at University College, London. Participants from the Civil Service took part in research sessions at lunch-time and in the evenings. Following a period of dormancy in the 1970s interest in teleconferencing has been renewed. Advances in micro electronics offer substantial cost reductions such that an American market research agency has just predicted a sixfold increase in video teleconferencing by 1985.

COMMUNICATIONS STUDIES AND PLANNING LTD.

I have read your Brochure and am interested in participating in Teleconference Decision Making.

Name: .....

Business Address: .....

.....

Telephone Numbers: Work: .....

Home: .....

Available: AM/PM/LUNCHTIME/EVENING

(Delete as appropriate)

Selected Publications

Telecommunications and energy policy.
M. Tyler, M. Katsoulis, and Angela Cook
Telecommunications policy. Vol. 1, No. 1, December 1976

Teleconferencing: is video valuable or is audio adequate?
R. Pye and E. Williams
Telecommunications policy, Vol. 1, No. 3, June 1977

New telecommunications hardware and its role in office activities.
H.A. Collins
Paper read at the IBG Spring Meeting, Kings College London, 12 May 1978

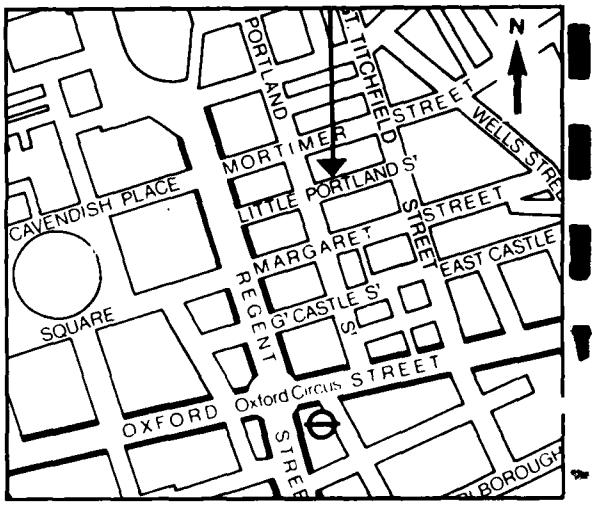
Business Telecommunications
M. de Smith
Computer Communications, Vol. 2, No. 3, 1978

Teleconferencing: the meeting of the future — now.
R. Pye and J. Springate
Management Services in Government, August 1978, Vol. 33, No. 3.

Telecommunications and the electronic office: some implications for planners and users of communications services.
M. Tyler
Paper read at 'Post Office Telecommunications — the way ahead?' ISL Information Studies Ltd Conference, 25-26 September 1978, London.

The impact of telecommunications on planning and transport
Ian Young
In 'Transport and Public Policy Planning' Bannister, D. and Hall P. (Eds).

Where we are



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01-637 9757
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B 3 QUESTIONNAIRES

Examples of the two questionnaires used, the Medium Questionnaire and the Group Perception Questionnaire, are included in this section.

Name .....

Date .....

MEDIUM QUESTIONNAIRE

After using the system and before leaving this room, would you please help us by spending a few minutes answering these questions.

In each case, choose the alternative which, in your opinion, best describes your experience today.

In comparison with your expectation of a similar discussion held under face to face conditions:-

1. Were you on the whole

   a) more satisfied ☐
   b) as satisfied ☐
   c) less satisfied ☐

2. Was the discussion

   a) more task orientated ☐
   b) as task orientated ☐
   c) less task orientated ☐

3. Was it

   a) more time consuming ☐
   b) as time consuming ☐
   c) less time consuming ☐

4. Did you contribute

   a) more than usual ☐
   b) as much as usual ☐
   c) less than usual ☐

5. Was your degree of control over the direction taken by the discussion

   a) greater than usual ☐
   b) same as usual ☐
   c) less than usual ☐

6. Were the equipment and facilities distracting ?

a) Yes
b) No

7. Were the equipment and facilities helpful ?

a) Yes
b) No

8. Did you find the visual image

a) natural
b) peculiar in any way

Please comment .....
.....

9. Was the pattern of the meeting

a) normal
b) different in any way

Please comment .....
.....

10. Did the other participants appear over this system

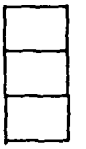
a) more cooperative
b) more competitive
c) the same

11. Similarly, were they

a) more aggressive
b) less aggressive
c) the same

12. Were they

a) more friendly
b) less friendly
c) the same



Thank You For Your Time

CONFIDENTIAL

A.R.P.A.

GROUP PERCEPTION QUESTIONNAIRE

NAME:_____ DATE:_____

ROOM:_____ GROUP NUMBER:_____ CONSECUTIVE No._____

1. Please rank in order who you think dominated the conversation most, during the last discussion.(Please include yourself).

	ROOM
MOST 1.	_____
2.	_____
3.	_____
LEAST 4.	_____

2. Please rank in order who you think contributed the most to the discussion during the last task. (Please include yourself).

	ROOM
MOST 1.	_____
2.	_____
3.	_____
LEAST 4.	_____

3. Please rank in order who you think influenced most the decision made during the last discussion. (Please include yourself).

	ROOM
MOST 1.	_____
2.	_____
3.	_____
LEAST 4.	_____

ANNEX C VISITS AND EXTERNAL ACTIVITIES

ANNEX C VISITS AND EXTERNAL ACTIVITIES

1. General External Activities

As part of the aims of the research were to generate ideas to improve teleconferencing, it was considered that part of the research time should be spent in discussion with other researchers and practitioners in the fields of teleconferencing, and in taking every available opportunity to be involved in teleconferences. It is not always possible to attribute specific ideas and directions resulting from these activities, but they are a necessary part of the general process of involvement in the research area.

Three trips were made to the United States during this contract:

- J. Birrell attended the WEX conference in Madison Wisconsin in May 1980. The WEX conference is the annual focus for anyone concerned with advances in teleconferencing. A separate report of the conference is included in this annex.
- B. Stapley and I. Young visited Washington in July 1980 to hold discussions with DARPA representatives, most notably Dr. Clinton Kelly, on the progress of both this specific project and research program in general. In the course of this visit, both Dr. Stapley and Mr. Young saw the 'Virtual Space' teleconference design at Decision and Design Inc., and Mr. Young had discussions at the Architecture Machine Group at MIT.
- In September 1980 Dr. Stapley and Mr. Young attended, at the request of DARPA, a three-day workshop of DARPA contractors held at New Paltz, New York. Discussions were also held with colleagues in the teleconference area at Bell Laboratories, Holmdel New Jersey, and the Alternate Media Center at New York University.

In addition to specific visits, members of the project team took part in international teleconference demonstrations held by members of Bell Laboratories. In one instance three members of the team participated in the same teleconference from three locations: Dr. Stapley at the 9th Annual Human Factors Conference at Red Bank New Jersey; Mr. Young at AT&T studios at 195 Broadway, New York

City, and Mr. Birrell at CS&P offices in London.

An opportunity was also taken during the year to try audio conference facilities in use in the British Government.

2. The WEX Conference

In May 1980 the Center for Interactive Media in the University of Wisconsin Extension (WEX) held its annual conference on "Teleconferencing and Interactive Media". The attendance figures of this conference have grown steadily over the past three years (300 in May 1980) and it is now possibly the foremost annual conference of its kind. This increase in attendance is indicative of the present resurgence of interest in teleconferencing internationally. With such interest the amount of research around the world is multiplying. It therefore follows that keeping up with recent developments becomes increasingly difficult as more people become involved and the scope of the discipline becomes wider. Communications Studies and Planning Ltd., therefore, felt that a member of staff should attend and cover the conference at WEX as part of the work carried out for DARPA under contract MDA-80-C-0200.

The Director of the Center for Interactive Media, Lorne Parker, coordinated the third annual conference held at WEX. In his opening address he called for a fresh look at the whole area of interactive media.

> "Teleconferencing and other interactive media are reaching out to improve communications, but they also raise critical issues:
>
> What are the uses, benefits and costs of audio and video systems?
>
> What are the future trends for communications satellites?
>
> How can computer conferencing/computer messaging systems and videotex services best be used?
>
> How can teleconferencing and other interactive systems be integrated?"
>
> (Lorne Parker)

It was these issues which were the focus at the WEX conference.

The range of papers was wide and varied in both type and area of application. Some papers were simple descriptions of in-house systems and sharing of hands-on experience. Others described fundamental research and recent technical developments. While others still discussed

their plans for the future and described teleconference systems designed but not yet built. Areas of application for interactive media included:

- business and government
- health and medicine
- education
- research and design (program and technical)
- videotex, computer conferencing and messaging.

3. Major Conclusions from the Conference

It must be said that the WEX conference contained little to convince anyone that teleconferencing has come very far in the last 4-5 years. While a number of technical advances have been made in this time (portable slow-scan video, videotex and computer conferencing), there was little evident growth in large scale multi-point or video-teleconferencing. Market forecasters for teleconferencing still enthuse about the future and large corporations ready themselves for the teleconference rush and need for satellite bandwidth. At the moment teleconferencing has been more successful in cases where a very strong need is present, as when dictated by geographical considerations, in certain fields like education and medicine or when users or organizations involved do not have to meet the full cost of system use.

Few video systems have evolved beyond the experimental or planning stages of development. In contrast audio and audiographic systems are developing quickly and modular systems are enjoying some success. Such systems, however, are mainly internal developments for organizations meeting specific user needs rather than general commercial developments.

4. Review of Papers Attended

Papers were held concurrently throughout the conference. As a consequence it was not possible to attend all papers and selection was made as far as possible for relevance to the contract. Those papers which were covered were from the following sessions:

- business and government
- education
- research and design.

The business and government section of the conference was dominated by representatives of corporations describing their services, both available and planned.Some work was reported which described the virtues of teleconferencing, its advantages over travel and the market forecasts, of major U.S. national carriers.

Of greater interest to us was another group of papers which described corporate experiences of a number of teleconference systems. These systems, which have been used over a number of years experimentally, include audio-only, audiographic and video systems.

The papers attended in the education session dealt with the applications of communication technology to tele-education with discussion of the problems involved. The papers did not limit themselves to effectiveness of teleconferencing but to many of the institutional problems caused by teaching in "non-traditional ways".

In most cases the delivery systems, whether radio, television, cable, satellite or computer, performed well although some technical problems were experienced. However, organizational problems were the major limitation to tele-education.

Decision problems surround the use of the equipment, cost factors and implementation were one kind of problem. Also experienced were problems of timetabling, synchronization of remote sites and involvement of the students.

In the research and design papers new equipment was demonstrated and the presentation of results from experimental teleconferences were presented.

One of the common experiences with the audio-only teleconferences referred to at WEX, is the problem of visual loss and the associated problems with communicating diagrams, text or ad hoc drawings. This may be overcome with full motion video, but this technique is both expensive to implement and constrained in its use often requiring studio-based equipment.

This led to a push in the development of a number of add-ons to standard audio equipment. Two papers covered this aspect of teleconferencing. Anthony Marsh of Bell-Northern Research reviewed the developments in recent years of audiographics systems. In his paper he outlined the development of electronic aids to audio teleconferencing:

- facsimile
- slow-scan video
- computer based text transmission
- and the Electronic Blackboard.

His conclusion, with which many at the conference agree, is that where videoconferencing due to experience has failed both narrow-bandwidth and audiographics can succeed since it has yet the ability to satisfy users' needs.

The second paper, by Robert Grisetti of Arthur D. Little Inc., carried on to discuss the prospects for integrated voice, data, and graphics telecommunications. However, while integrated systems are seen as the way to go for the future, Mr. Grisetti says that it will be at least 8 years before there is sufficient market definition for fully integrated systems to be successful. In the mean time modular systems make up the bases of the market in audiographic teleconferencing. Several such pieces of equipment were on show at the conference. A number having been in operation - in-house - for some years.

Demonstrations were carried out of some of the electronic aids to audioconferencing. Portable slow-scan video, the Electronic Blackboard and facsimile. These modular systems are becoming increasingly sophisticated and are felt by users to be of real benefit to teleconferencing. The portable slow-scan receiving equipment, demonstrated by Thomas Hoff of Roche Labs, is housed in a briefcase-sized container. Using an audio cassette recorder audiocoupler for telephone handset,

and 5 inch TV monitor it will allow slow-scan pictures from a central site to be received at any remote location with an available telephone. Picture quality was good. Transmission takes 8 secs and cost at present is $3,000 for remote terminals and $5,000 for central site transmitter. However, only the remote portable receive unit commercially available, packaged by Darome the transmit units is an internal development. Roche Labs do not use slow-scan/audio teleconferencing as a travel substitute. These briefcase-sized terminals are used by travelling employees to contact central offices for expert help, advice and generally to increase "fire-power". Thus they augment already existing patterns of communication.

Access to expert help is also an outcome of the integration of slow-scan into the medical profession. Chris Higgins, Earl Dunn and Sally Irwin described the background and offered a practical demonstration of the video system used by the Sovix Lookout hospital in Ontario Canada. The problem here is that the general hospital serves such a large area that outlying communities requiring medical help may be situated some 1,600 km away. Travel over such distance is difficult and often impossible depending on conditions. It is time consuming and wasteful of valuable medical resources. This means that long delays before diagnosis and treatment are experienced and doctors are involved in travel when they could be more gainfullly employed. This travel by doctors is clearly impractical. It has not provided possible to entice doctors to reside in these areas as the social and economic pressures force them to live in cities. Nor has it proved practical to transport patients to the cities for expert medical help. Government has therefore been under some pressure to provide a way of providing as good medical attention in these outlying areas as exists in the cities.

This has led to telemedicine being successfully implemented to overcome the problem. This method brings together doctor and patient using teleconferencing equipment and paramedical help. Paramedics have the advantage that they are quick and simple to train. They can therefore be more numerous than doctors, but unfortunately lack the in-depth knowledge and experience only available from fully-trained doctors. Like La Roche laboratory's use of portable slow-scan the

Savix Lookout hospital relies on the technique of having someone out in the field who is in immediate audiographic contact with a pool of expertise. Similarly both systems use slow-scan and telephoneconferencing for this link.

The demonstration at the May conference of both these slow-scan systems shows the flexibility and usefulness of this kind of visual augmentation of audio-teleconferencing. Sally Irwin demonstrated the medical slow-scan system showing how patients could be shown to doctors and expert advice given immediately to the paramedic. This included x-ray photography, ECG readout and pictures of skin or other visable anatomical condition.

Slow-scan is also in use by the Ford Motor Company. James Sobczak demonstrated their colour slow-scan system which at present links Ford's factory in Detroit to Brentwood in England. Ford's users feel that discussion of complex components is made far easier and more effective than would occur by using telephone only or even facsimile transmission of diagrams and drawing. "Just point the camera and you can show your colleague any view you want of the equipment, it is very easy and flexible" said Mr. Sobczak.

G. Ronald Christopher demonstrated the Electronic Blackboard as used by the Airforce Institute of Technology. Using a link with Hawaii he showed the versatility of the equipment for showing ad hoc text and graphics simultaneously on site and at remote locations. To on-site classroom members the equipment is not significantly discernible from a normal portable blackboard. However, at remote locations students are able to see blackboard rates as they are generated on a screen projection or TV monitor. This has the obvious advantages of negating the need for extra preparation material for remote sights and reducing the need for travel by tutors. The use of the electronic blackboard successfully augments the two-way audio links previously used for tracking. The result has been considerable travel and preparation cost saving and increased perceived involvement by students at remote locations.

Whereas the Electronic Blackboard has obvious advantages in education for its duality as blackboard and graphics transmitter, facsimile seems to be fulfilling this role in business. It is cheaper than slow-scan and is able to handle both prepared and ad hoc material. At NEX Samuel Fordyce of NASA HQ discussed some of the newest generation of facsimile equipment. The new NASA high speed facsimile uses a satellite circuit and is able to transmit at 56 kbit/s. The machines, built by Nippon Electric, transmit a page of typical text in 10 secs at normal resolution and in 17 seconds at high resolution. This facsimile system has been an invaluable addition to the existing audio teleconference network linking 11 NASA installations and Marshall space flight centre. Lately the network has been expanded to include 89 terminals handling some 90,000 pages of information including those transmitted during teleconferences.

Teleconferencing is not limited to audiographics systems and to demonstrate this some papers were given of experiences with audio-only and audiovisual systems.

Souix Plummer described a highly-used audio teleconference and a newly implemented video system used in government by the Legislative Affairs Agency in Alaska. Both systems are enjoying some success. However in her paper it was pointed out that there is a strong need for these systems due to the geographical conditions and distances involved. The LAA audio system links 13 remote Alaskan communities to the state capital and to Washington D.C.. The usage of the system is high (3-5 teleconferences daily) mainly being used for public hearings. This is the most heavily used of the two systems. the videoconference system being used mainly for special purpose meetings involving major personalities or objects to view. The usefulness of teleconferencing is supported by the success of the working systems, but it should be remembered that usage is only high when the need is strong. In Alaska teleconferencing provides the only reasonable way for the public to be involved in the legislative process and to meet with their representatives in Washington D.C.

The issue of video-teleconferencing was discussed separately by Jan Loeber of AT&T, Karen File of Booz-Hamilton Consultants, and Richard Harkness of Satellite Business Systems.

AT&T view of teleconferencing in general, and the promotion of Picturephone Meeting Service in particular, stems from the changes in the structure of the working population of the United States. Jan Loeber, in his keynote address, described the white collar workers as mainly being involved in communication - some 60% of the time being involved in the activity. Also the number of workers involved in communication activities is increasing rapidly such that not only is the amount of communication increasing per white collar worker but there is a general increase in the numbers of white collar workers in comparison to the rest of industry. His conclusion, then, is that communications needs during the next few years will increase dramatically both quantitatively and qualitatively. This points the way to a future of not only larger telecommunications networks, but of greater more advanced communications.

Jan Loeber feels that some of the potential needs will be fulfilled by the Picturephone Meeting Service. This teleconference service incorporates a full motion studio-based system which is hireable to customers as needed. Karen File of Booz-Hamilton and Allen has investigated the potential this service has for substitution of existing meetings. Her conclusion is that videoconferencing can substitute for very large numbers of meetings involving travel. However the method of simple interviewing employed is would indicate that much more rigorous investigation need be employed to support the conclusion.

Richard Harkness described the work Satellite Business Systems are doing to satisfy possible user needs for videoconferencing. The market they are looking at involves high volume communications between major vocations within large organizations. Here it is felt that there is a great need for a full matrix videoconference system which can overcome a number of the problems associated with travel which cause inefficiency within business organizations. The major point to be made here was that, while the concept of videoconferencing is readily acceptable to potential users, even minor difficulties (technical faults, organizational or locational difficulties, loss of travel-related status) can deter even the most interested of personnel.